SCIENCE ABSTRACTS.

Section A.—PHYSICS.

OCTOBER 1904.

GENERAL PHYSICS.

2444. *Allotropic Silver for the Preparation of Conducting Fibres.* **N. A. Dubois.** (Phys. Rev. 19. pp. 48–50, July, 1904.)—Fibres of quartz or other suitable material may be readily rendered conducting by covering them with an alcoholic emulsion of allotropic silver, and when the alcohol has evaporated treating with gaseous hydrochloric acid, which converts the badly-conducting allotropic silver films into ordinary silver. Such fibres are found to work well in a quadrant electrometer. The allotropic silver is prepared by adding 10 per cent. sodium hydroxide solution to a mixture of 200 c.cm. of 30 per cent. ferrous sulphate solution with 280 c.cm. 40 per cent. sodium citrate solution till no permanent precipitate forms, and mixing this with 200 c.cm. of a 10 per cent. silver nitrate solution when the allotropic silver is precipitated. W. H. Sı.

2445. *A New Method of Producing Tension in Liquids.* **J. T. Jackson.** (Roy. Dublin Soc., Proc. 10. 8. pp. 104–113, Sept. 30, 1903.)—Water flows through a glass tube having a constriction at one place, the pressure at which is smaller the greater the velocity. The pressure of the water is measured by a closed tube manometer at the place where it enters the constriction, the pressure at the constriction being deduced from the relation $p_1 - p_2 = F_{12}(C)$, where p_1 and p_2 are the pressures at the two points considered, C the current, and F_{12} a function of the geometrical shape of the tube. If the water column is broken at the constriction the pressure p_2 is then the vapour pressure of the water. C and p_1 are then observed. With the same current as before, and an unbroken column, p_1 is again observed, and since $p_1 - p_2$ is the same as before, p_2 can be calculated. In this way the author found that for ordinary tap-water a negative pressure of 77 in. of mercury could be obtained without any previous purification of the water, in which condition the tension that the water can support statically is very small. S. G. S.

2446. *Conservation of Mass.* **J. Joly.** (Roy. Dublin Soc., Trans. 8. 2. pp. 23–52, Oct., 1903.)—Experiments were made to determine whether in certain reactions weight is altered. This is in criticism of Heydweiller's results [see Abstract No. 1760 (1901)]. The form of balance and other details are fully described. It is concluded that no inertia effect corresponding to the least weight change measurable by the most sensitive balance arises in these experiments. J. W. P.

2447. *Pressure-Distribution round Spheres in a Viscous Fluid.* **S. R. Cook.** (Phil. Mag. 6. pp. 424–436, Oct., 1903. Paper read before the Amer. Assoc. for Advancement of Science.)—An experimental verification of mathematical theory. The apparatus consisted of a glass sphere blown on a capillary tube and mounted in a tube 160 cm. in length, through which a constant flow of air was maintained. A small hole was drilled in the sphere. The pressure was determined by a water manometer connected to the capillary. Diagrams illustrating the pressure distribution are given. J. W. P.

2448. *Work done by Forces Operative at One or more Points of an Elastic Solid.* **Rayleigh.** (Phil. Mag. 6. pp. 385–392, Oct., 1903.)—A mathematical consideration. J. W. P.

2449. *Granular or Spicular Structure in Solids.* **G. T. Beilby.** (Chem. News, 88. pp. 167–168, Oct. 2, 1903. Abstract of paper read before the British Association (Sect. A) at Southport, 1903.)—The author finds that films of metal, just thin enough to transmit light freely, show a granular texture by transmitted, and a spicular appearance by reflected light. The surface layer of metals has similar properties to these films, and is distinct from the remainder of the mass in some respects: due allowance being made for the difference between the supports in the two cases. Films in a strained condition are more opaque than those whose strain has been relieved by annealing; thus gold-leaf is in its condition of greatest opacity. The author considers that cutting, polishing, or annealing temporarily confers a degree of freedom upon the molecules of the surface layer, and that the granular structure is largely a result of surface tension. The structure can readily be developed in a thin film of a viscous fluid, *e.g.*, oil or fuchsin on glass, varnish on a non-reflecting support. It is also seen in films of oxide or sulphide on metal surfaces. The author has produced the structure on every solid hitherto tried. Granular or spicular structure would seem to be associated with deposition from solution—it is seen in thin films of metal deposited either chemically or electrolytically. In precipitates from very dilute solutions there are three stages in the appearance of the solid: (1) Spicules or very thin spicular films; (2) granules; (3) crystals. F. R.

2450. *Travelling Waves in Flowing Water.* **P. Forchheimer.** (Akad. Wiss. Wien, Sitz. Ber. 112. 2a. pp. 1697–1720, Dec., 1903.)—When water flows down inclined shallow conduits any waves forming will tend to increase because the water velocity depends upon the depth, and the water is deeper just above the crest than below in the hollow; in deep conduits the waves vanish. The waves travel faster than the water flows, and the discharge is therefore not uniform. If w is the velocity of the travelling wave, v the velocity of the water, v_1 the velocity under the crest, and v_2 the velocity under the hollow, z_1 the depth of water under a crest, i the sine of the angle of wave inclination, and c a constant, then the author finds $v_1 = c\sqrt{z_1 i}$, and $w/v_1 = 1 + v_2/v_1 - (v_2/v_1)/(1 + v_2/v_1)$. Since v_2/v_1 lies between the limits 0 and 1, w/v_1 is limited between 1 and 1·5; this follows also from the amount of water discharged. The constant c varies as $z^{0\cdot 7}$, just as according to Flamant the water velocity in pipes varies as the 0·7 power of the diameter. The wave velocities increase gradually with uniform gradient of the bed, and several small waves may unite to a large wave. The author has experimented with troughs built up of planed or unplaned boards, and Weltzebach has studied the waves in the shallow Schmittenbach, whose bed is partly paved and partly lined with wood. Pouring water down almost vertical troughs of 9 m. length, the author found the upper 5 m. free of waves, and then wave crests at distances of 0·5, 1·4, 2·0, 2·8, 3·4 m. from the bottom. His experimental wave velocities are generally a little greater than the calculated values. H. B.

2451. *Capillary Ripple on Mercury Produced by Blowing through a Fine Jet.* **T. Terada.** (Mathematical and Physical Soc., Tokyo, 2. 11. pp. 138–139, April, 1904.)—The author has investigated the effect of blowing air through a fine jet on to the surface of mercury, for different positions of the nozzle and at various pressures. As the jet is brought nearer the surface or the pressure increased, the ripples gradually deepen, and circular stationary waves appear. When the nozzle touches the surface, by suitably adjusting the pressure, a musical note is produced, the pitch of which depends upon the pressure and the depth of the jet below the surface. The general relation $n = C - kd - k'p$ is found to hold, where n is the frequency, d the depression below the surface, p the pressure, and C, k, and k' are positive quantities approximately constant for a given tube. The motion at the mouth of the tube may be considered analogous to that of a circular membrane, so that the frequency is given by the formula $n^2 = (2r\pi + g\rho\lambda^2/2\pi)/\lambda^3\rho$ in which r is the surface tension of the mercury, ρ its density, and λ the wave-length. W. H. St.

2452. *Determination of Density of very Dilute Solutions.* **G. Mie.** (Boltzmann Festschrift, pp. 326–332, 1904.)—The author points out that in the determination of densities of very dilute solutions, owing to the difference in the coefficients of expansion of the sinker and of the liquid, the temperature must be read to within 0·001°. He proposes to use pure water contained in a very thin walled glass globe with a neck drawn out to a capillary. Using this globe as a sinker, the coefficient of expansion is only very slightly different from that of the very dilute solution being investigated. L. H. W

2453. *Compressibility of Solids.* **J. Y. Buchanan.** (Roy. Soc., Proc. 73. pp. 296–310, May 7, 1904.)—Determination of absolute *linear* compressibilities of Pt, Au, Cu, Al, and Mg at pressures of from 200–300 atmospheres, between 7° and 11° C., by methods the same as those applied to determine the compressibility of glass in the *Challenger* observations, 1875–1880. The methods are described. Linear compressions: Pt, 0·1835 per million per atmosphere; Au, 0·260; Cu, 0·288; Al, 0·558; Mg, 1·054; Hg, 1·33; flint glass, 0·973 and 1·02; German tubing glass, 0·846. A. D.

2454. *Dielectric Cohesion of Mixtures.* **E. Bouty.** (Soc. Franç. Phys., Séances, 2. pp. 134–136, 1904.)—As a rule mixtures have dielectric cohesions which are the mean of the dielectric cohesions of the components; that is, at higher pressures (above 4 mm. Hg) where the influence of the walls of the containing vessel is relatively unimportant. [See Abstracts Nos. 966 and 967 (1904).] A. D.

2455. *Dielectric Cohesion of Mercury Vapour.* **E. Bouty.** (Comptes Rendus, 138. pp. 1691–1692, June 27, 1904.)—The critical field for mercury, in volts/cm., is $\gamma = -50 + 354\sqrt{p(p+4)} + 0{\cdot}19/p^2$. The dielectric cohesion is therefore 0·85 that of air, and for the density of mercury vapour is remarkably small. Mixture of mercury vapour with H or CO_2 have greater dielectric cohesions than the mean of their components; and mixtures of mercury vapour and argon have the dielectric cohesion enormously greater than the mean. A. D.

2456. *Viscosity of Air.* **F. G. Reynolds.** (Phys. Rev. 18. pp. 419–431, June, and 19. pp. 37–47, July, 1904.)—History of the viscosity coefficient of air; full bibliography. By torsion with a suspended *sphere,* many difficulties are obviated. Small differences of barometric pressure have no effect upon the logarithmic decrement, which is also unaffected by the amplitude of swing but increases with increase of temperature. Coefficient for air at 20·72° is 0·00018697. By a method with cylinders equivalent to the sphere it is 0·00018711. Röntgenisation of the air makes hardly any difference; if anything it increases the period of swing and lowers the logarithmic decrement, both to an extent apparently increasing with the duration of the experiment. A. D.

2457. *Atmospheric Friction on Even Surfaces.* **A. F. Zahm.** (Phil. Mag. 8. pp. 58–66. Note by **Rayleigh,** pp. 66–67, July, 1904.)—The experiments investigate the friction of free air flowing swiftly over even surfaces, and determine the law of its variation with speed of flow, length and quality of surface. The air speeds range up to 40 ft. per sec., and the surface friction is measured by the longitudinal displacement given to a board suspended by long steel wires. Friction for a pine board 24 in. × 25·5 in. ranges from 0·000224 to 0·001366 lbs. per sq. ft. for speeds 6·38 to 16·61 ft. per sec. The total resistance of all bodies of fixed shape and aspect is expressible by $R = av^n$, v being the wind speed, and a and n constants. Comparison with Froude's results is made. Rayleigh makes remarks on dynamical similarity. Applications to aeronautics are dealt with in Abstract No. 1893B (1904).] J. W. P.

2458. *Normal Piling.* **J. D. Everett.** (Phil. Mag. 8. pp. 30–37, July, 1904. Communicated by the Physical Society.)—A consideration of various methods of piling, and an explanation of the geometrical conditions underlying Osborne-Reynolds' theory of the universe. J. W. P.

2459. *Transverse Vibrations of Helical Springs.* **H. L. Bronson.** (Amer. Journ. Sci. 18. pp. 59–72, July, 1904.)—Seven springs of brass wire were employed, and comparison was made with rubber cords under similar conditions of tension, length, &c. While the frequency is expressed by the formula usually employed for ordinary strings, yet the results are very different on account of the great variations of the length with the tension. The approximate constancy of pitch for a considerable change of length is observed for the rubber cords and in a still more marked degree for the springs. J. W. P.

2460. *Diffusion of Hydrogen through Hot Platinum.* **O. W. Richardson, J. Nicol,** and **T. Parnell.** (Phil. Mag. 8. pp. 1–29, July, 1904.)—Winkelmann has measured the rate of diffusion of hydrogen through the walls of a hot platinum tube exposed to the atmosphere externally [see Abstract No. 2279 (1902)]. It was found that this was not proportional to the pressure, as might have been expected, but to the square root of the pressure. This result can be explained by supposing the hydrogen to dissociate into atoms, the dissociated part only being capable of diffusion. The authors have repeated these experiments, and have sought to interpret their results theoretically. The tube was heated electrically and its temperature taken by a thermocouple; for other experimental details the paper must be referred to. A number of curves are given connecting temperature with mass of hydrogen diffusing at constant pressure, and also mass of hydrogen diffusing with the pressure, the temperature being constant. By plotting log Q ($Q =$ mass of H escaping) against log P ($P =$ pressure) for a series of constant temperatures, it is found that $Q \propto P^{\frac{1}{2}}$, within the experimental errors, over a range of pressure from 1 to 760 mm. This, the authors show, can be explained by supposing that dissociated atoms pass freely through the platinum. There is no clear evidence of the existence, either of any appreciable fraction of dissociated gas, even at the lowest pressures, outside the platinum, or of any appreciable fraction of the gas passing through in the combined state. The results cannot be explained on any theory which makes the number of diffusing particles proportional to the number of molecules of hydrogen per c.cm. outside, as, *e.g.*, by supposing an action between the hydrogen molecule and the platinum, wherein one atom is taken up and the other rejected. As a mean of 15 concordant determinations, the heat of dissociation of hydrogen inside the platinum is found to be 36,500 cals. Finally, the experiments point to the view that the ionisation produced by hot platinum in an atmosphere of hydrogen is due to collisions between the atoms of the gas dissolved in the metal. R. S. W.

2461. *Gravitation Constant.* **B. Davis.** (Science, 19. pp. 928–929, June 17, 1904.)—If we take as unit of mass that mass which is associated with one electromagnetic unit *each* of positive and negative electricity, then since the charge e on an electron is 10^{-20} e.-m. units (H. A. Wilson), and $e/m =$ (average datum) $1{\cdot}52 \times 10^{7}$ e.-m. units, m (the mass of one electron) $= 0{\cdot}65 \times 10^{-27}$ gm., and the number of electrons carrying one e.-m. unit of electricity is 10^{20}, the mass of which would be $0{\cdot}65 \times 10^{-7}$ gm. For one unit *each* of + and − electricity, the mass would be twice as much, $= 1{\cdot}35 \times 10^{-7}$ gm., which is our new unit of mass. With this new unit of mass gravitational force becomes—

$$\frac{6673}{10^{11}} \times \frac{(1{\cdot}35 \times 10^{-7})^2}{r^2} = \frac{1}{(3 \times 10^{10})^2} \cdot \frac{1}{r^2},$$

with a coefficient *numerically* equal to V^2 or on the e.-m. system ($\mu = 1$) to K^2. The ratio of electrical to gravitational force is $\frac{1}{Kk} = (3 \times 10^{10})^4$, where k is the gravitational constant with the new unit of mass. A. D.

2462. *Gyrostatic Method for Measuring Earth's Rotation.* **A. Föppl.** (Phys. Zeitschr. 5. pp. 416–425, July 15, 1904. From the Sitzungsber. der. k. bayr. Akad. d. Wiss. Math.-phys. Klasse, 34. p. 5, 1904.)—A large gyrostat, electrically driven, and rotating about a horizontal axis is suspended by three long wires. The deviation of the axis of the gyrostat from its zero position is observed. The motor runs at about 1,800 r.p.m. The cases of zero line in the meridian and perpendicular to the meridian are considered. The measurements are made by observing the successive swings, the period being about six minutes. A close agreement between calculated and observed deviation is found. J. W. P.

2463. *Anomalies of the Climate of Iceland,* 1851 *to* 1900, *and their Relations to the Climate of N.W. Europe.* **J. Hann.** (Akad. Wiss. Wien, Sitz. Ber. 113. 2a. pp. 183–269, Jan., 1904.)—According to Teisserenc de Bort, the subtropical high-pressure area of the Azores and the low-pressure area of Iceland are the great centres of atmospheric action in Western Europe. The author bases his examination of these relations on the daily observations which Olaf Thorlacius made at Stykkisholm, Iceland, during the whole period 1845 to 1891; analyses of these records have been published in the Journ. Scottish Meteor. Soc. by A. Buchan, who first drew attention to the relative importance of the climate of Iceland, and by the Meteorological Department of Norway. The author has also studied the records for Reykjavik, 1829 to 1837. Comparing the climatic anomalies of Iceland with those of Greenwich, Brussels, and Vienna, the author finds that, in general, high pressure in Iceland means low pressure on the Western Continent, that low pressure in Iceland is accompanied by warm weather in Western Europe, and that there is also a distinct inverse ratio in the rainfalls; since 1878, however, the rainfalls have taken a parallel course. The inverse ratio in pressure and temperature is particularly well marked for Edinburgh and Scotland (A. Buchan). There is further a pronounced inverse relation between Stykkisholm and Ponta Delgada (Azores); this was first shown by Hoffmeyer in 1878, and by Meinardus for 1880–1881, and is confirmed by the author for the period 1865–1890. The author proceeds to a study of the meteorology of Iceland, making use of the records of the Danish Meteorological Institute and the publications of Willaume Jantzen; the climate depends greatly on the changeable accumulation of ice on the coast. Angmagsalik, 670 km. west of Stykkisholm, on the east coast of Greenland, is about 5° C. colder than the latter (February, 8° colder), owing to the cold polar current running down the east coast of Greenland, and the warm current on the west coast of Iceland. The difference in temperature between the east and west coasts of Greenland is, however, smaller than is generally believed, Godthaab being about 1° C. warmer than Angmagsalik. On the icefields of Northern Greenland the winds blow with phenomenal regularity from the interior to the coast (E. A. Peary). H. B.

2464. *Nephoscope Observations in the West Indies,* 1899–1903. **F. H. Bigelow.** (Monthly Weather Rev. 32. pp. 166–169, April, 1904.)—The eleven stations of the U.S. Weather Bureau in the West Indies are fitted with Marvin nephoscopes. The reductions have been made on an improved method; the charts of azimuths and velocities of motion are plotted on the scale 1 mm. = 1 m. per sec., and reproduced on the scale 0·6 mm. = 1 m. per sec. There is a general, strong, eastward drift in the temperate zones, and a westward drift in the tropics. The position of the curve which separates the two drifts changes with the season. Assuming that the foot of the curved arch rests on nearly the same latitude (between 30° and 35° lat. N. and S.) in winter and summer, and crosses the Atlantic about Florida or South Carolina, the arch lies chiefly in the Northern Hemisphere during the Northern summer, and skews to the south during the Southern summer. The circulation in the tropics is very complex. In the winter months the reversal takes place over Cuba (lat. 22° N.) between the cumulo-stratus and alto-cumulus levels, at an altitude of about 3,500 m., over Kingston (lat. 17°) at about 6,400 m., over Willemstad and Port of Spain (lat. 12°) at 8,000 m. In summer the reversal is, as a rule, at about 10,000 m. in the cirrus, but the westward drift is feeble from the sea-level up to the highest levels. As regards maximum horizontal velocities, the westward circulation generally increases from the sea-level up to the strato-cumulus, falls off to a minimum in the alto-stratus, and becomes irregular in direction; a maximum eastward velocity is then attained in the cirrus level. The assumed regularity of the Trades does not hold for any really large region, the circulation being much localised. The levels from alto-stratus to cirrus, from 4 to 6 miles up, are most concerned in hurricane formation; the hurricane tubes have that depth of 4 or 6 miles, while the tubes of the tornadoes of the United States, built up on the same mechanical principle, rarely are more than 1 mile in depth. The approximate normal circulation, plotted from the combined winter and summer observations, shows one single westward drift in the five lower levels, but two counter-currents in the upper four levels. In the western stations of the West Indies the vectors point southward, in the eastern stations northward; between them is an area of counterflow and of low pressure, which is important for the generation of hurricanes. H. B.

2465. *A Twenty-six Day Period in Daily Means of the Barometric Height.* **J. P. van der Stok.** (Konink. Akad. Wetensch. Amsterdam, Versl. 13. pp. 18–34, June 24, 1904. Translated from Versl. van de gewone vergadering der Wis- en Natuurkundige Afdeeling, May 26, 1904.)—Schuster having, in 1899, applied the theory of probabilities to the determination of the first couple of Fourier coefficients in analysing the records of magnetic declination, observed at Greenwich during 25 years, and having further suggested the rearrangement of the records according to different periods, the author states that his method is more reliable and shorter than Schuster's periodograph. He measures out successive data on vectors drawn from an origin at equal angular distances; the method is equivalent to the determination of a point in a plane by means of many inaccurate observations, as worked out by Schols. Grouping the daily barometric means observed at Batavia since 1888, according to a solar day, first of 25·80, and then of 25·70, and of 25·87 days, he finds that there is no real evidence for the existence of any of these periods, or almost equally good evidence for all of them. Yet the indications are in favour of the 25·8-day period. Schuster had assumed periods of 26 and 27 days in his analysis of the magnetic declination; the author concludes that in this latter case there is much greater probability of a fluctuation period of 25·8 days, and that more value is to be attached to the variation of the magnetic elements in higher latitudes than to meteorological oscillations in the Tropics. H. B.

2466. *Palæochemistry of the Ocean in Relation to Animal and Vegetable Protoplasm.* **A. B. Macallum.** (Canad. Inst., Trans. 7. pp. 535–562, March, 1904.)—The relative proportions of the four elements K, Na, Mg, Ca in the ocean have always been changing. The primeval ocean contained them in proportions that we now find in river water, or rather in the fresh-water shed from areas covered with Archæan rocks: nearly as much K as Na, a little more Mg, abundance of Ca. The Na was taken up from crystalline rocks as carbonate (O. Fisher), not as chloride; this would affect Joly's estimate of the age of the earth. The pre-Cambrian strata contained little limestone, and the shells of the early brachiopods were chitinous, not calcareous. With the appearance of living forms Mg, Ca, K were gradually eliminated from the sea-water, while Na increased relatively. The first living forms were unicellular, and as they persisted for a long period, these organisms and their protoplasm acquired a fixed relation to the elements. Since the formation of the soil and the appearance of vegetable land forms, the transference of K from the land to the sea has diminished, and the percentage of Ca in the sea has also become stationary owing to the action of sea organisms. The unicellular organisms meanwhile became multicellular and developed circulatory systems; but the blood plasma of vertebrates contains Na, K, Ca—though less Mg—in the same proportion as the sea at present, and this is due to heredity. The proportions of the four elements in living protoplasm are unknown, as this substance precipitates K and Ca, and possibly Na and Mg, in itself and in its adventitious structures. The marked influence of heredity is shown by the fact that the karyokinetic processes are the same in the animal and vegetable cell, and seem to have continued unchanged from the primeval period of the unicellular organisms. The paper comprises tables of the composition of the waters of rivers, lakes, and the sea. The small amount of Mg in sea-water is ascribed to the insolubility of magnesia and to the deposits of dolomites. Reference is made to Forchhammer, Sterry Hunt, F. W. Clarke, Katz, and others. H. B.

2467. *Modulus of Elasticity of Rocks, Velocity of Seismic Waves, and Frequency of After-Shocks.* **S. Kusakabe.** (Mathematical and Physical Soc., Tokyo, 2. 11. pp. 142–148, April, 1904.)—From bending experiments with rocks made with the aid of four mirrors, of which two are attached to the support of the fulcrums and two to the specimen, the author [see Abstract No. 7 (1904)] has concluded that Hooke's law does not hold for rocks even for stresses equivalent to a few per cent. of the breaking stress. Applying these conclusions to seismology, he infers that for the determination of the velocity of the seismic wave, the mean value of the elastic constant for one complete cycle has to be taken. The seismic wave conductivity is many times greater for archæan than for cainozoic rocks; coincidence of the curves of iso-frequency with the geological distribution of rocks, in the case of the Mino-Owari earthquake after-shocks, *e.g.*, proves that seismic waves are transmitted along the earth's surface which would be in accordance with Rayleigh and Lamb. The frequency curves for after-shocks is nearly hyperbolic. In sandstone the modulus of elasticity diminishes at higher temperatures, and seems to have a maximum at 9° C.; the velocity of propagation should, therefore, diminish in the warmer, deeper earth strata; but there may be detached paths of maximum velocity along some veins of old rocks, and further experiments are required. H. B.

2468. *The Spectroscopic Double Star β Aurigæ.* **H. C. Vogel.** (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 14. pp. 497–517, March 10, 1904. Astrophys. Journ. 19. pp. 360–381, June 1904.)—A lengthy discussion of the spectroscopic observations made on this star. The final result for the period is 3·9599 days, with a possible error of ±5 sec. The velocity of the system in the line of sight is −21 ±1 km. The author has also investigated the change in appearance of the spectrum lines, and finds no connection between these changes and the relative position of the two components in their orbit. E. C. C. B.

2469. *Observations with the Bruce Spectrograph.* **E. B. Frost** and **W. S. Adams.** (Astrophys. Journ. 19. pp. 350–356, June, 1904.)—Four stars are first given whose radial velocities vary; they all have spectra of the Orion type, and are as follows: 9 Camelopardi, with extreme velocities of +12 and +3 km., while the second component has a velocity varying from +7 to −12 km.; κ Cancri, in which the principal component has a velocity varying from +88 to +2 km., and the second component a velocity varying from −135 to −97 km.; μ Sagittarii with a variation between +46 and −34 km., and δ′ Lyrae with a variation between +8 and −88 km. The Orion Nebula has also been investigated at the points located by the three principal stars in the trapezium; as a mean of ten results the velocity was found to be +18·5 km. As regards the two second brightest stars in the trapezium, Bond 640 and 619, the velocities are +20 and +48 respectively. The latter case of Bond 619 is curious as it differs so much from that of the nebula. No variation in the radial velocity of ζ Cancri was found from a comparison of two plates taken in December, 1902, and March, 1904; the same result −12 km. was found in each case. E. C. C. B.

2470. *Spectrum and Orbit of δ Orionis.* **J. Hartmann.** (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 14. pp. 527–542, March 10, 1904.)—That this star shows a variable velocity in the sight line had already been pointed out by Deslandres, who calculated the period to be 1·92 days. The author has taken a number of photographs of the spectrum between 1901 and 1903, from which he calculates the period to be 5·7333 days. There were nine lines of hydrogen and helium used in the measurements; an interesting fact was noticed in the case of the calcium line at $\lambda = 3934$, which does not suffer any change in position during the velocity changes of the star. The position of the line is quite constant, corresponding to a velocity of + 16 km., while the other lines in the spectrum indicate velocities between + 133 and − 70 km.; a further point is that the line is very sharp, thereby differing from all the other lines. From a very careful investigation of all his plates the author has come to the conclusion that the second component star is dark and shows no spectrum, for although the spectrum lines of the system are diffused and broad, there is no sign of doubling. Unless therefore the calcium line $\lambda = 3934$ is the only line shown by the second component, an extremely unlikely thing as the second component would necessarily have a mass ten times that of the bright star, it is probable that the absorption causing the 3934 line does not take place on the star at all; there is probably a cloud of calcium vapour between us and the star, which causes the absorption of this ray. A similar fact was observed in the case of Nova Persei. If the velocity of the sun in space in relation to δ Orionis is calculated it is found to be + 18·1 km. and + 8·7 km. in relation to Nova Persei. As the calcium cloud in the latter case was found to have a velocity of + 8 km. it is very probable that the cloud in each case is motionless in space. The elements of the orbit have been calculated by the Lehmann-Filhe's method and are given in the paper. E. C. C. B.

2471. *Comet* 1903 *Borelly and Light Pressure.* **S. A. Mitchell.** (Astrophys. Journ. 20. pp. 63–68, July, 1904.)—Beginning with a short statement of the varying critical diameters of substances at which the light pressure becomes equal to the gravitational attraction, the author endeavours to apply the tests to the phenomena of cometary tails as far as observed facts will supply the necessary data. Assuming that the chief vapours in comets are some form of hydrocarbon having a specific gravity about 0·8, and a critical diam. of about 1·9 μ, an outline is given of the explanation suggested by Arrhenius to account for the curvature and multiplicity of the tails of comets. The measures of the comet 1903 Borelly, made by Albrecht from photographs taken at the Lick Observatory, give the data for determining the curvature of the comet's tail and the magnitude of the repulsive forces forming the tail. Then, using the parabolic elements computed by Perrine, it is possible to determine the velocity of the comet along the radius vector and perpendicular thereto. There is a third velocity caused by light pressure along the radius vector, but directed away from the sun, and the resultant of the three gives the motion in the comet's tail. Combining the motions to and from the sun, along the radius vector, the direction of the tail can be determined. It is thus possible, if the velocity and direction of the tail be known, to calculate the component of the velocity induced by light pressure. Tables are given showing a series of values thus obtained. [See Abstracts Nos. 834 (1902) and 60 (1904).] C. P. B.

2472. *Reversal of the D_3 Line seen in the Sun's Spectrum.* **H. Kreusler.** (Deutsch. Phys. Gesell., Verh. 6. 13. pp. 197–198, July 15, 1904.)—The helium D_3 line is usually seen in the solar prominences as a bright line, and is not to be found in the ordinary solar spectrum as a dark line. In a group of spots, however, on June 12, the author saw the line reversed; the line was not visible in the spectrum of the spots themselves but in their immediate neighbourhood. E. C. C. B.

2473. *Relation between Spectra of Sun-spots and Stars.* **N. Lockyer.** (Roy. Soc., Proc. 74. pp. 53–54, July 19, 1904.)—The sun-spot spectra observed during the period 1892–1903 have invariably indicated that the elements whose lines were chiefly affected were vanadium and titanium, this being confirmed by the work of Cortie on a different region of the solar spectrum. In the work on stellar classification according to temperature it was concluded that the general temperature of Arcturus is probably appreciably lower than that of Capella, judging from the fact that the spectrum of Capella extended further into the ultra-violet than that of Arcturus. Subsequent detailed comparisons of the variations in intensity of the dark lines in the two stars and the sun respectively led to the conclusion that the spectra of the sun and Capella are practically identical, but that many lines are intensified in the spectrum of Arcturus. In the majority of cases these specially intensified lines are due to vanadium and titanium, and this suggests the similarity between the absorbing atmosphere of Arcturus and the vapours producing the special absorptions in sun-spot spectra. Incidentally, this may be taken as confirmation of the ideas formulated by De La Rue, Stewart, and Loewy, that the spots are produced by the downrush of cooler material. [See also Abstract No. 1602 (1904).] C. P. B.

2474. *Spectra of Neptune and Uranus.* **V. M. Slipher.** (Nature, 70. p. 390, Aug. 18, 1904. Lowell Observatory Bulletin, No. 13.)—The photograph of the spectrum of Neptune extends from $\lambda = 4300$ to D, and shows apparently a brightening on the more refrangible side of *b*, indicating intrinsic emission, though perhaps this may be due to the contrast afforded by two strong absorption bands. $H\beta$, and probably $H\gamma$, is stronger than in the solar spectrum, indicating free hydrogen in the planet's atmosphere. The spectrum of Uranus from F to $\lambda = 3500$ exhibits no departure from the normal spectrum, but one photograph apparently shows a line at D_3, indicating the presence of helium. A comparison between the spectra of the two planets shows that, though present, free hydrogen is not so abundant in the atmosphere of Uranus as in that of Neptune. Three bands at $\lambda = 5100$, $\lambda = 5430$, and $\lambda = 5770$ are also stronger in the spectrum of the latter, indicating that the atmosphere of Neptune is much more extensive than that of Uranus. The origin of these three bands is unknown, unless the second and third are due to water vapour; the author suggests they may be due to gases lighter than hydrogen and helium. E. C. C. B.

REFERENCES.

2475. *Portable Standard Gramophone.* **F. Hauser.** (Akad. Wiss. Wien, Sitz. Ber. 112. 2a. pp. 1397–1406, Dec., 1903.)—In this instrument the arm bearing the diaphragm is pivotally mounted at one end on a carriage, which slides by means of a sleeve on a fixed guide of circular cross-section, and which has a sectional nut engaging with a leading screw; the other end of this arm has an adjusting screw which slides on a fixed, flat guide. The driving chain is kept tight by means of a jockey pulley. The instrument is made of magnalium. The original paper contains two good illustrations of the instrument and a detailed description. C. K. F.

2476. *Damping Effect of Suspension by Rubber Cords.* **H. Bouasse.** (Journ. de Physique, 3. pp. 511–524, July, 1904.)—The author suspends a mass M by means of a rubber cord, 4 mm. in diam., of length L from the end of one of the prongs of a tuning-fork (of about 50 periods) which is excited electromagnetically. Referring to previous publications on the elasticity of vulcanised rubber in the Annales de la Faculté des Sciences de Toulouse, vols. v. and vi., he points out that the one-sided loading of a tuning-fork by a heavy mass of about 1 kg. does not disturb the oscillations, while a small mass attached to one of the prongs would interfere with the period. The theories of Helmholtz, Cornu, and Hamy do not cover his suspension because, among other reasons, the vibrations of the soil are not instantaneously transmitted along the cord, as these theories assume. The amplitude of the vibration of the mass M will, he finds, be small provided the quotient $p\lambda/2\pi M$ be small, which it is in practice; p is the mass of the cord per unit length, and λ the respective wave-length. It is, however, not advisable to stretch the rubber too much at the expense of the stability of the support. The author's theory is not applicable to the vibrations of walls, because those vibrations are not regular, and further, are both transversal and longitudinal. H. B.

2477. *Sounding Device.* **A. Jakimoff.** (Collection of Physical papers devoted to the memory of T. T. Petrouchewsky, pp. 7–11, 1904.)—In order to simplify the design of the Thomson sounding device, the author suggests having the air in the annular space between the internal wall of an iron tube and a cylindrical rod, compressed by the pressure of the sea-water, the cylindrical rod being fitted with a metrical scale and fixed concentrically in the interior of the tube by means of a nut screwed to its lower end, the surface of the rod being provided with a coating sensitive to the action of water. After the experiment the nut is unscrewed so as to loosen the rod, from which the maximum level of the water is determined. A. G.

2478. *The Abdank-Abakanowicz Integraph.* **Hammer.** (Zeitschr. Instrumentenk. 24. pp. 213–217, July, 1904.)—The integraph of the late Abdank-Abakanowicz has been improved by its maker, G. Coradi, of Zürich, and has been described in a pamphlet written by H. Lossier and published by the maker. The paper is a description based upon this pamphlet, but embodying the most recent improvements. When the tracer of the instrument is guided along any differential curve the guide-wheel, which while rolling turns about its point of contact, will describe the corresponding integral curve. H. B.

2479. *New Piezometer.* **Buchanan.** (Comptes Rendus, 139. pp. 238–241, July 18, 1904.)—A cylindrical glass vessel, closed above by a rubber stopper, is provided with a bulb below. This bulb contains mercury into which a glass tube dips; the glass tube passes axially through the stopper and is open above. The annular space between the tube and cylinder is filled with water of known volume and density. The apparatus is lowered into the sea-water to a measured depth; the water forces the mercury out of the tube into the cylinder so that the sea-water mixes with the other water. The temperature of the sea-water at the depth is determined independently. The author gives a formula for the compressibility of the sea-water at the respective depth, allowing for the compressions of the various parts. Experiments prove that the rubber stopper will keep perfectly tight. H. B.

2480. *New Automatic Gas Pump.* **C. E. S. Phillips.** (Phil. Mag. 8. pp. 218–220, Aug., 1904. Communicated by the Physical Society.)—The pump consists of three parts—a small pump driven by an electric motor, a four-way control valve, and a final modified Toepler pump. The valve is of the slide type, but as its travel is only ⅛ in. an electromagnet suffices to actuate it. There is a small hole in the slider flange, so that the inrush of the air into the lower chamber, and consequently the rise of the mercury into the upper chamber, is checked; the mercury falls rapidly, however. The circuits of the slider are broken in external mercury cups. H. B.

2481. *Bending of Rock Salt.* **W. W. Coblentz.** (Phys. Rev. 16. p. 389, June, 1903. Paper read before the Amer. Physical Society, April 25, 1903.)—It is found possible to bend plates of rock salt 0·5 mm. thick by holding in the mouth for a few minutes (temperature about 36° C.), by placing in a saturated salt solution at 50–70° C., or by holding in a Bunsen flame at 1,400°. In each case the rock salt remains brittle for a short time, after which bending begins and then suddenly occurs more rapidly. A small plate 3 × 0·5 × 0·1 cm. held in a vice with a weight of about 75 gm. suspended from the free end did not show a visible bending after 25 days at room temperature. Whether it is a case of slipping due to gliding planes or simply a case of viscosity like that of pitch has not been determined. W. H. S.

2482. *Rubber Films on Water.* **G. Jäger.** (Akad. Wiss. Wien, Sitz. Ber. 112. 2a. pp. 1685–1696, Dec., 1903. Inst. Theoretische Physik, Wien.)—An account, with photographs, of singular forms and movements assumed by rubber films on the surface of water. A. D.

2483. *System of Pendulums Representing Compound Molecules.* **A. Filippini.** (Accad. Sci. Torino, Atti, 39. 11a. pp. 502–513, 1903–1904.)—Mathematical discussion of the case of two pendulums, one suspended from the other. The two bobs alternately come to rest. Analogies with the doublet lines of the spectrum of two equal neighbouring conductors carrying oscillating currents. The longer period is lengthened, the shorter shortened, if the lower bob be very small. If the two pendulums be equal the oscillations are the sums of two periods which stand in the ratio 131 : 54. A. D.

2484. *Noises Made by Projectiles and Meteors.* (Monthly Weather Rev. 31. p. 476, Oct., 1903.)—According to parallax observations meteors are visible at altitudes of 100 miles, even where the atmosphere should be too rarefied to produce glowing and sound waves. The paper suggests four possible causes for the latter: (1) Direct impact between the meteor and the air; (2) inrush of the air into the vacuum; (3) the meteor revolving rapidly about its axis strikes the air in all directions, producing a rapid succession of waves; (4) continuous sputtering of the burnt particles. Experts from the U.S. Naval Academy, Annapolis, Ind., were asked about their opinion; P. A. Alger favours (2); A. C. Diffenbach and J. Strauss speak only about the noise made by projectiles. H. B.

2485. *Methods of Water Absorption by Rocks.* **P. de Heen.** (Bull. Acad. Roy. Belg. pp. 63–65, 1904.)—The author explains the occurrence, that in certain strata the water entirely disappears and is found again in lower strata, as being due to "micropores," the cross-sections of which are of the same order of magnitude as the molecular range of the water, so that owing to their greater capillary effect the ordinary pores remain quite empty. The phenomenon has been artificially reproduced. L. H. W.

2486. *Foucault Pendulum Systems.* **E. K. Adams.** (Elect. World and Engineer, 43. pp. 1190–1194, June 25, 1904.)—It has been elsewhere suggested to keep Foucault pendulums in constant motion by raising and lowering the centre of suspension synchronously with the oscillations of the pendulum and in proper phase relation with the same. Several mechanical arrangements which may be employed to automatically produce this vertical motion of the centre of suspension are described in the present paper. None of them have yet been tried, however. [See also Abstract No. 692 (1904).] J. B. H.

2487. *Armour-piercing Projectiles and Critical Velocities.* (Engineer, 96. pp. 429–430, Oct. 30, 1903.)—Beyond certain critical velocities, which seem to depend on the armour encountered, projectiles tend to break up rather than to pierce the armour (Tresidder). This is probably due to the condition of molecular vibration in which the projectile is immediately after impact. The cap, perhaps, tends to preserve the point and retard the break-up of the projectile, and is useful at velocities beyond 1,800 ft. per sec. The cap raises the critical velocity of 6-in. projectiles by about 1,000 ft. per sec. A. D.

2488. *Flow of Steam from Nozzles.* **J. Perry.** (Nature, 68. pp. 624–625, Oct. 29, 1903.)—Calculations are made showing how an expanding mouthpiece (which in the case of water would increase the flow, and in which the velocities are less where the cross-sections are greater) does not increase the flow in the case of air or steam, the velocities further being greater where the cross-sections are greater. R. E. B.

2489. *The Explosive Wave.* **E. Jouguet.** (Comptes Rendus, 139. pp. 121–124, July 11, 1904.)—Looking upon an explosive wave as a quasi-wave of collision across which the pressure increases very rapidly, and assuming that behind the front of the wave the dissociation is negligible, the author calculates the speed of propagation of the wave in thirteen different mixtures of gases by means of formulæ developed in a previous paper [see Abstract No. 2131 (1904)]. His results agree tolerably well with those obtained experimentally, so that the assumption is allowable for a first approximation. R. E. B.

2490. *Elasticity Theory.* **J. A. Vollgraff.** (Ann. d. Physik, 14. 3. pp. 620–625, July, 1904.)—A mathematical criticism of the St. Venant method. J. W. P.

2491. *Reflections Suggested by the New Theory of Matter.* **A. J. Balfour.** (Nature, 70. pp. 368–372, Aug. 18, 1904. Science, 20. pp. 257–266, Aug. 26, 1904.)—Inaugural address to the British Association at Cambridge, 1904.

2492. *Physiological Effects of Low Barometric Pressure.* **A. Mosso.** (Accad. Lincei, Atti, 13. pp. 680–687, June 19, 1904.)—P. Bert says that low atmospheric pressure acts on the organism only through reducing the partial pressure of the oxygen. Experiments (described) show this not to be the case: on maintaining constant the partial pressure of oxygen but reducing the aggregate barometric pressure to about one-third of an atmosphere, physiological disturbances (rapid breathing, sleep, &c.) set in, which depend probably upon acapnia (deficiency of CO_2 in the arterial blood). A. D.

2493. *Muscular Energy.* **A. Chauveau.** (Comptes Rendus, 139. pp. 108–114, July 11, 1904.)—The author has studied the work done when a load is lowered under the same conditions as when the load is raised [see Abstract No. 2134 (1904)]. The internal work to be performed in lowering a load is greater than when the load is only to be sustained, and smaller than when it is to be raised, and subdivision of the load is advisable as in lifting. H. B.

2494. *Ascent of Water in Trees.* **G. Macloskie.** (Science, 20. pp. 116–118, July 22, 1904.)—Theory based upon the Hydrostatic Paradox, the atmospheric pressure acting below and the water ducts being practically rigid and capped at top. The material in the ducts is not water, but foam, with the air-bubbles disposed axially. There are transverse septa which permit diffusion but not the passage of air; and in each section, between two septa, the pressure is less than in the section below. As the water is removed at the leaves, water travels upwards in a thin peripheral layer in the sections below. The dynamical part of the problem is explainable mainly by the *vis a tergo* of the atmospheric pressure at the base. A. D.

2495. *Gravity and Chemical Action.* **W. P. Dreaper.** (Chem. News, 90. pp. 53–55, July 29, 1904.)—The author brings forward an indirect theory of gravity, according to which the latter is not a constantly acting force but is the sum of all the forces, passing or desiring to pass from one body to another through a resisting medium. It is shown from this that an intimate relation exists between gravitation and chemical affinity, while other widely differing chemical phenomena—antagonistic behaviour of certain elements, dissociation, colloidal state, &c.—may be readily explained. T. H. P.

2496. *Height of the Atmosphere Calculated from the Disappearance of the Blue Sky after Sunset.* **T. J. J. See.** (Nature, 68. p. 526, Oct. 1, 1903.)—The author watches the disappearance of the blue colour as darkness comes on after sunset, and calculates the height of the atmosphere or of the illuminated particles in it from the depression of the sun at that moment, taken from the Nautical Almanac. He found on Aug. 30, in five observations: 125, 130, 133, 135, 132 miles, while Newcomb doubted that any of the meteors of 1867 were higher than 100 miles. H. B.

2497. *Libration and Diurnal Nutation of the Earth's Crust.* **Folie.** (Annal. Soc. Sci. de Bruxelles, 28. pp. 172–174, 1903–1904.)—The author confirms observations first made in September and October, 1903. During the winter the changes were small, but on March 20 and 21 A. Rouma observed large oscillations again. The method is not explained. The curve reproduced shows a minimum on March 20, h. 17, while on September 23 the minimum occurred at h. 19; the extreme amplitude of the curve is about ± 25 mm. The author assumes that there is diurnal nutation in addition to libration. H. B.

2498. *Meteorological Observations in Western Australia.* **W. E. Cooke.** (Government Astronomer's Report to Colonial Secretary, pp. 1–142, 1903.)—Observations made at Perth Observatory and other places in W. Australia during the year 1902.

2499. *Measurement and Utilisation of Fog.* **P. Leonard.** (Monthly Weather Rev. 32. pp. 169–170, April, 1904.)—In the arid district of San Diego, California, drifting fogs prevail in the early summer which are caught by the leaves and help vegetation. The author suggests to combine the rain-gauges with wire-gauze cylinders in order to collect and measure this fog. In commenting upon this suggestion, it is objected that a measure of the moisture caught by trees and plants would not be obtained in this way. It would be more important to conduct the moisture down into the ground by oblique wires or rods. H. B.

2500. *Meteorology in the Neighbourhood of Barometric Minima and Maxima at Kiew.* **V. Drapczyński.** (Akad. Wiss. Wien, Sitz. Ber. 113. 2a. pp. 71–96, Jan., 1904.)—The data were taken from the daily synoptic charts of the Centralanstalt at Vienna, from which those days were selected on which Kiew was, at 7 a.m., situated in a cyclonic or anticyclonic area. The calculations were made for the years October, 1892, to September, 1902, separately for winter and summer months, 1,377 days being selected out of 3,651, 612 days being cyclonic and 765 anticyclonic. The author's central area has a radius of 444 km., the zone about it a radius of 666 km.; these areas are divided into eight sectors. His quadrants are numbered S.E. (I.), S.W. (II.), N.E. (III.), N.W. (IV.). He finds that the air temperature decreases with rising barometer, and that the anticyclone has a lower temperature than the cyclone; in the cyclone the relative humidity is, in winter, higher in front, in summer higher in the rear; the opposite holds for anticyclones. Cloudiness and probability of rain decrease with increasing air pressure; there is more probability of rain in winter than in summer, but the amount of rain greater in winter both in cyclones and anticyclones. The greatest deviation of the wind direction from the gradient is in the S. sector, the smallest in the W. H. B.

2501. *Pressure of Sunlight and its Bearings on Astronomy and Meteorology.* **S. A. Mitchell.** (Monthly Weather Rev. 32. pp. 217–220, May, 1904.)—The author gives a historical sketch of the views of Newton, Kepler, Euler, Halley, Olbers, Bredichin, and Arrhenius on comets and their tails, referring to the demonstration of the radiation pressure by Nichols and Hull [see Abstract No. 1301 (1904)] and to the Krakatoa eruption. From Albrecht's photographs of the comet of 1903, taken at the Lick Observatory, he calculates that the diameters of the particles forming the three tails were 0·1, 1·0, 1·33 μ. Editorial comments on the Zodiacal Light and Bishop's-ring are added. H. B.

2502. *Height of Clouds by Automatic Photography.* **A. Sprung.** (Zeitschr. Instrumentenk. 24. pp. 206–213, July, 1904.)—In 1899 the author described an automatic apparatus for determining the height of clouds by means of taking simultaneous photographs from two stations, the two plates being placed in position and exposed for two hours by closing an electric circuit [see Abstract No. 1639 (1899)]. The zenith is deduced from the paths of stars on the photographs. The author now deals with the complicated calculations and errors; details of observations are not given. On Lüdeling's suggestion he proposes that all cloud heights should be expressed as $H = z + c$, where c is the elevation of the station above sea-level. H. B.

2503. *Variability of Temperature in the Antarctic.* **H. Arctowski.** (Comptes Rendus, 139. pp. 90–91, July 4, 1904.)—In 1875 Hann calculated the variability of the temperature from the monthly and yearly means of the differences between consecutive days. Making these calculations for 70 stations, he found that the variability was greatest in the Asiatic and North American Continents, and decreased towards both the oceans and the Equator. The author applies this method to the observations made by the *Belgica* during her stay in the Antarctic in 1898–99, taking the data from his report on the results of the expedition. He finds differences of more than 6° (from 6 to 19·6°) on 66 days of the year—as high a variability as at Winnipeg, the highest known—and an average difference between two consecutive days of 3·3°, also an exceptionally high figure. The closeness of the isothermals in the Antarctic and the numerous barometric depressions and ever-changing winds would explain the extreme variability of the climate. H. B.

2504. *Definitive Orbit of Comet,* 1874 *II* (*Winnecke*). **G. Burggraf.** (Akad. Wiss. Wien, Sitz. Ber. 113. 2a. pp. 97–182, Jan., 1904.)—Full analysis is given of all the available observations of the comet, and the definitive orbit determined therefrom. C. P. B.

2505. *Cosmical Radio-activity.* **A. Schuster.** (Electrician, 51. p. 898, Sept. 18, 1903. Chem. News, 88. pp. 166–167, Oct. 2, 1903. Paper read before the British Association (Section A) at Southport, 1903.)—The fact that every physical property hitherto discovered in one element has been found ultimately to be shared by all, suggests that radio-activity may be a common property of matter. There is some analogy between the effects observed in the neighbourhood of large masses, *e.g.*, the sun and the earth, and in that of radio-active bodies. The earth is charged with negative electricity which is constantly leaking, hence it must be constantly renewed. The sun, again, has coronal influences which point to radio-active effects. If so, the connection between sun-spots and terrestrial magnetism is obvious. P. E. S.

2506. *Radio-activity and the Age of the Sun.* **G. H. Darwin.** (Nature, 68. p. 496, Sept. 24, 1903.)—The writer, in a letter to "Nature," gives a revised estimate of the computed values of the age of the sun and its probable future existence, as necessitated by the recent work on radio-active substances, the presence of which in the sun may be capable of greatly affecting its store of available energy. No definite scale can yet be assigned, but it is suggested that the former estimates simply based on gravitational theory may be increased ten- or twenty-fold. C. P. B.

2507. *Spectrum and Radial Velocity of* χ *Cygni.* **G. Eberhard.** (Astrophys. Journ. 18. pp. 198–203, Oct., 1903.)—Two series of photographs of the spectra of this star in 1901 and 1902 give from the absorption line spectrum a constant radial velocity of about −20 km. Very little is known of the continuous spectrum, but from measurements of certain lines the velocity was found to be in 1901, +2·4 km., and in 1902, −2·3 km., thus showing analogy with *o* Ceti. Interesting details are also given of changes in the intensity of certain lines during the periods the star was under observation. E. C. C. B.

2508. *Lunar Eclipse Observed by Means of Selenium Cells.* (Scientific American, 89. p. 242, Oct. 3, 1903.)—Having obtained an electric-current record of a partial sun eclipse, which could not be observed at Berlin by ordinary means owing to heavy fogs, E. Ruhmer watched the almost total lunar eclipse of April 11–12, 1903, with the aid of a selenium cell, placed in a parabolic mirror. The resulting curve is very regular. H. B.

2509. *Theory of Planetary Transits Over the Sun's Disc.* **L. Weinek.** (Akad. Wiss. Wien, Sitz. Ber. 112. 2a. pp. 1752–1777, Dec., 1903.)—The paper gives an analysis of the general equations of condition for the computation of planetary transits over the sun, for the purpose of determinations of solar parallax. C. P. B.

2510. *Definitive Orbit of Comet,* 1890 *III* (*Coggia*). **J. Rheden.** (Akad. Wiss. Wien, Sitz. Ber. 113. 2a. pp. 3–51, Jan., 1904.)—The definitive orbit is computed from an analysis of all the available observations of the comet. C. P. B.

2511. *Definitive Orbit of the Planetoid* 347 (*Pariana*). **G. Boccardi.** (Accad. Sci. Torino, Atti, 39. 9a. and 10a. pp. 439–468, 1903–1904.)—The elements are worked out, and the perturbations due to Jupiter, Saturn, and the earth considered. L. H. W.

2512. *Meteorological Observations at Turin.* **E. Ferrero.** (Accad. Sci. Torino, Atti, 39. pp. 1–53, Feb. 28, 1904. Extract.)—The observations taken at the observatory of the University of Turin during 1903. [See also Abstract No. 996 (1903)].

2513. *Track of Biela's Comet.* **J. v. Hepperger.** (Akad. Wiss. Wien, Sitz. Ber. 112. 2a. pp. 1329–1376, Dec., 1903.)—A summary is given of Struve's and Secchi's work in 1852, the last-named observer having discovered the second portion B_{II} of the comet on Aug. 25. Struve describes in detail the relative appearances of B_I and B_{II} between Sept. 18 and 28, as seen with the Pulkowa refractor. The observations obtained at Rome, Berlin, and Pulkowa are discussed in detail, together with the probable errors and corrections. Owing to the faintness and fluctuations of light of B_I and B_{II} there was some doubt as to which object was under observation at each place. Tables of calculations are given of the ephemerides of both comets, and of the perturbations due to the various planets, followed by a summary of the differences in geocentric coordinates of the two comets during their visibility Sept. 14 to 30, 1852, the distances between their cores, and details of the comparison stars used. H. F. H.

2514. *Equipment of the Yerkes Observatory.* (Engineering, 77. pp. 593–594, 596, 597, April 29, and pp. 663–667, 668, 669, May 13, 1904.)—This is a technical description of the instrumental equipment of the world's largest observatory, illustrated by photographs and dimensioned working drawings of the 40-in. equatorial refractor and dome. C. P. B.

2515. *Solar Parallax.* **Bouquet de la Grye.** (Comptes Rendus, 138. pp. 1369–1375, June 6, 1904.)—The article gives a summary of the procedure of the reduction of the French observations of the transit of Venus in 1882, for the determination of the solar parallax. C. P. B.

2516. *Variable Stars in Orion Nebula.* **J. G. Hagen.** (Astrophys. Journ. 19. pp. 344–349, June, 1904.)—The author gives a list of stars for assisting in the identification of these variables in the region of the Orion nebula, in connection with his map of T. Orionis, with cross-references to the publication of other workers, and proposes to furnish a map later showing all details of the group. C. P. B.

2517. *Photographs of the Solar Atmosphere.* **H. Deslandres.** (Comptes Rendus, 138. pp. 1375–1381, June 6, 1904.)—The general results of the past ten years' work with the various forms of spectroheliograph are discussed, and a new instrument described by means of which the author is endeavouring to obtain composite photographs of the solar atmosphere, &c., using various combinations of slits which are so arranged as to pass only predetermined radiations. [See Abstracts Nos. 23, 292 (1903); 541, 1022 (1904).] C. P. B.

2518. *The Escape of Gases from Atmospheres.* **G. Johnstone Stoney.** (Phil. Mag. 7. pp. 690–700, June, 1904.)—The author finds fault with certain statements made by Cook in a recent paper (Nature, 69. p. 487, March 24, 1904). He pointed out that there are two methods of approaching the study of the phenomenon, namely, inductively, by arguing upwards from events which are found to have occurred, or to be in process of occurring, in nature, and deductively, by drawing inferences from the behaviour known to prevail in certain models of gas. The two methods lead to opposite results, and, therefore, one must be erroneous. Cook expresses the opinion that the numerical results arrived at by the deductive method will have to stand until they can be disproved by other *à priori* reasoning. Now the author points out that this method of reasoning leads to the conclusion that the moon possesses an atmosphere which is now known to be not the case; he therefore concludes that this method is quite unreliable. The errors probably arise from too wide an application of Maxwell's law for the distribution of speeds in a kinetic system. [See also Abstract No. 734 (1904).] E. C. C. B.

LIGHT.

2519. *Electro-ethereal Theory of the Velocity of Light.* **Kelvin.** (Phil. Mag. 6. pp. 437–442, Oct., 1903. Paper read before Section A of British Association at Southport.)—The effect of the presence of electrionic vibrators in ether on the velocity of light traversing it is determined. The consideration is mainly mathematical. J. W. P.

2520. *The Total Radiation from a Hefner Lamp.* **O. Tumlirz.** (Akad. Wiss. Wien, Sitz. Ber. 112. 2a. pp. 1382–1396, Dec., 1903.)—In 1888 the author measured, after the method of J. Thomsen, the radiation falling from a Hefner amyl acetate lamp upon 1 sq. cm. of a screen placed at a distance of 1 m., the normal to the screen being horizontal and passing through the centre of the flame. He found this total radiation equivalent to 0·1483 . 10^{-4} gm. cals. per sec., or 618 ergs, and the visible light radiation to represent 2·4 per cent. of this quantity, and therefore equivalent to 15·15 ergs. Ångström obtained in 1899, with his compensation pyrheliometer, the value 896 ergs for the total radiation and 14 ergs for the light energy, the latter representing only 0·90 per cent. of the total. The author has now renewed his researches with the aid of an apparatus made by Lenoir and Forster, of Vienna. A double-walled cylinder of copper is, by a long glass tube, connected to a glass bulb, charged with bone oil. The connection between the inner cylinder and the tube is effected through a flanged ebonite disc, provided with an inner and an outer thread, cut in opposite directions. The axis of the cylinder lies horizontal and passes through the centre of the flame, whose light first falls upon a plate of rock salt, 56 mm. in diam., 4·5 mm. in thickness, forming the bottom of the outer cylinder. This plate of rock salt is only mounted for the experiments, and as a rule kept in a desiccator. The copper walls are covered with lamp-black, which absorbs 94 per cent. of the radiation (Kurlbaum). The measurements are based upon the rate of cooling of the air in the inner cylinder after extinguishing the lamp. The author discusses the theory, and arrives at the conclusion that, under the conditions above stated, the total radiation is 0·162 . 10^{-4} gm.-cals. per sec., or 677 ergs. [See also Angström, Abstracts Nos. 1511 (1902), and 2524 (1904).] H. B.

2521. *Anomalous Propagation of Light in Optical Instruments.* **G. Sagnac.** (Comptes Rendus, 138. pp. 619–621, March 7; 678–680, March 14; and 139. pp. 186–188, July 18, 1904.)—Further details are given of the experimental verification of the view put forward in a previous paper [see Abstract No. 1824 (1904)], whereby the alteration of half a period suffered by a wave-front passing through a focus is explained as being the result of oscillations of phase and intensity, always present, but hitherto unrecognised. The author has repeated Zeeman's experiment with a new lens of less convergence, which, with a distance of 5 m. from the light source to the lens, gives conjugate foci of the ordinary and extraordinary rays at 2 m. and 3 m. respectively from the lens. It is pointed out that the phenomenon is only well shown when the light source is small and the angular diameter of the lens also small; when these are large there are several systems of phenomena superposed which partly obliterate each other's appearance. In the second paper the author points out that the variations of the oscillations in velocity of the waves are dependent on both the *extent* and "*form*" of the light source, and gives some values for definite examples used. In the third paper two further experimental determinations of the peculiar features of light propagation in the vicinity of a focal line are described. In the first of these a cylindrical lens is cut from a crystal of Iceland spar, with one face plane and parallel to the axis of the crystal. This lens is then placed between two nicols either crossed or parallel, with its principal section at 45° to those of the nicols, and the whole system placed in a beam of light from a slit source. When the length of the slit is arranged parallel to the generatrices of the cylindrical lens, a series of rectilinear fringes are produced parallel to these generatrices. Close examination of the central fringe then shows a change of period between the foci for the ordinary and extraordinary rays. By a slight addition, using a plate of Iceland spar, the phenomenon has been photographed. The author also describes how these phenomena, which usually disappear quite near to the focal line, may be photographed throughout all positions by suitable modifications of the size of the light source and of the diaphragm covering the lens. C. P. B.

2522. *New Principle of Photographic Lens Construction.* **C. Beck.** (Photographic Journ. 44. pp. 172–178 ; Discussion, pp. 178–180, June, 1904.)—A photographic lens of $f/4\cdot5$ is produced by placing, at certain distances apart, four thin lenses, two concave and two convex, all made of glass with the same mean refractive index and all with the same focal length. The advantages obtained are achromatism, telescopic central definition, freedom from distortion and flare, and a 60° flat field. In the *discussion*, **S. P. Thompson** pointed out that if, by separating the lenses, it were possible to get rid of the aberrations, it followed that for any lens which was corrected for such aberrations, so that the back focus was right for all colours, there would also be the same magnifications for all colours. **S. D. Chalmers** said that the lens described did not perfectly satisfy the Petzval condition, and that absolute adherence to that condition was not so necessary as was generally supposed. G. E. A.

2523. *Colours in Metal Glasses and in Metallic Films.* **J. C. M. Garnett.** (Roy. Soc., Phil. Trans. 203. pp. 385–420, Aug. 17, 1904. Roy. Soc., Proc. 73. pp. 443–445, June 22, 1904. Abstract.)—The first part of the original paper was devoted to coloured glasses, and explanation of phenomena observed by Siedentopf and Zsigmondy. Expressions were obtained for the electric vector of the light scattered from a small metal sphere, when a train of plane polarised light falls upon it, and it was then proved that the metal particles seen in gold glass by the above observers are spherical in shape when the diameters are less than 10^{-5} cm. This fact throws light on the manner in which metals crystallise out of solution, the particles taking first a spherical form under the action of surface tension, and later, when they become too large for the focus of surface tension to overcome the crystalline forces, becoming amenable to the latter. Beilby previously arrived at similar conclusions [see Abstracts Nos. 1875 and 1894 (1904)]. The optical properties of a transparent medium containing metal spherules at distances apart considerably less than a wave-length of light were next investigated. It was shown that every such medium has a definite colour by transmitted light, depending only on the index of the medium, and the optical constants and the quantity of the metal, but not on the size or distance apart of the spheres. Metal glasses of this description will be called "regular." It was proved that the presence of metal spheres accounts for the optical properties of regular gold ruby glass, and that irregularities in effects of colour and polarisation sometimes exhibited are due to excessive distance between adjacent gold particles or to their excessive size. Experiments were described proving that this regular colour can be produced in a colourless metal glass containing the metal in solution (which is the state in the manufacture of gold or copper ruby glass before the second heating) by the β-radiation from radium. Thus a piece of clear gold glass and a piece of clear soda glass were exposed to the emanation for two days, when the gold glass had acquired an unmistakable pink tint, while the soda glass had turned an intense blue-violet. The second part of the paper dealt with media built up of metal spheres, when the volume of metal may have any value between zero and unity, instead of being very small. Explanations were given of change and loss of colour observed by Beilby in gold and silver films, also of changes of colour on heating observed by R. W. Wood in potassium and sodium films inside exhausted glass bulbs. In Part III. some evidence was brought to show that the allotropic silvers obtained by Carey Lea are particular cases of the media considered in Part II.

A. E.

2524. *Energy of the Visible Spectrum of Hefner Lamp.* **K. Ångström.** (Nov. Act. Soc. Sci. Upsala, 3. pp. 1–12, 1903. Phys. Rev. 17. pp. 302–314, Oct., 1903. Journ. de Physique, 3. pp. 587–590, July, 1904.)—This research has for its objects—(1) To determine the distribution of the energy in the spectrum of the lamp flame; (2) to determine in absolute measure the total radiation sent on a sq. cm. from a distance of 1 m. The limit of the visible spectrum towards the red was fixed at $\lambda = 7600$. The method employed was a calibration one, with incandescent carbon as comparison, and observations were taken with photometer, spectrometer, and bolometer respectively.

C. P. B.

2525. *Diffraction Theory of Microscope when Object is in Motion.* **R. T. Glazebrook.** (Phys. Soc., Proc. 19. pp. 157–159, July, 1904.)—When a grating, placed on the stage of a microscope and illuminated by plane waves, is moved in its own plane in a direction perpendicular to the ruling, the positions of the diffraction images do not change, but those seen in the view-plane move. This difference is shown to be due to change of phase in the diffraction images.

G. E. A.

2526. *Relation between the Photometric Brilliancy of an Incandescent Body and its Temperature.* **E. Rasch.** (Ann. d. Physik, 14. 1. pp. 193–203, May, 1904.)—Lummer and Kurlbaum in the case of glowing platinum express the relation between two intensities, ϕ_1 and ϕ_2, and the corresponding temperatures as follows: $\phi_1/\phi_2 = (T_1/T_2)^x$, where x depends upon the temperature and has the following values :—

Tabs.	900°.	1,000°.	1,100°.	1,200°.	1,400°.	1,600°.	1,900°.
x	30	25	21	19	18	15	14

Lummer further considers that as the temperature rises x approaches a constant value of about 12. If now we consider the fundamental equation underlying the physiological conception of brilliancy of light we have $d\phi/\phi = \xi\, dT/T^2$, where ϕ represents the sensibility of the eye to light. By integration we have $\log_e \phi = C - \xi/T$. If now we choose as unit ϕ_1, that intensity of light which is radiated by 1 sq. mm. of surface of an absolutely black body at the absolute temperature $T = \theta$, it is clear that the integration constant $C = \xi/\theta$, and thus the integrated equation will stand—

$$\log_e \frac{\phi}{\phi_1} = \xi\left(\frac{1}{\theta} - \frac{1}{T}\right),$$

or—

$$\phi = \phi_1 e^{\xi\left(\frac{1}{\theta} - \frac{1}{T}\right)},$$

or by putting—

$$\frac{\xi}{\theta} = a, \quad \phi = \phi_1 e^{a\left(1 - \frac{\theta}{T}\right)}.$$

Considering Lummer's formula, $\phi_1/\phi_2 = (T_1/T_2)^x$, if ϕ_1 is very nearly equal to ϕ_2, then—

$$(\phi_1 + d\phi_1)/\phi_1 = \left(\frac{T_1 + dT_1}{T_1}\right)^x,$$

and as dT/T is very small compared with 1—

$$\left(\frac{T_1 + dT}{T_1}\right)^x = 1 + x\frac{dT}{T},$$

and therefore $d\phi/\phi = x\,dT/T$. From what has gone before it is clear that $xT = \xi =$ constant (this can readily be seen by plotting Lummer and Kurlbaum's values of x against T, when the resulting curve is a rectangular hyperbola). We thus have $d\phi/\phi = x\,dT/T = \xi\,dT/T^2$. These results show that Lummer's contention that x approaches a constant value of 12 with rising temperature is quite wrong. Some further observations have been given by le Chatelier and Boudouard upon the connection between the photometric intensity and the temperature. As comparison source they used a standard candle. From a graphical expression of their results we find—

$$\log_e \frac{\phi}{\phi_1} = 13{\cdot}02 - \frac{19800}{T} = a - \frac{\xi}{T} = \xi\left(\frac{1}{\theta} - \frac{1}{T}\right).$$

Again taking results of Lummer and Pringsheim and of Nernst showing the relation between the surface brightness of the black body in terms of Hefner units and the temperature, we arrive at the values $a = 12{\cdot}943$ and $\theta = 2068{\cdot}4°$ (absolute); the value of a is very near that of 13·02 arrived at above, and θ is the absolute temperature at which the brightness of 1 sq. mm. of the black body equals the brightness of one Hefner candle. By means of the above the author has calculated the melting-point of iridium from an observation by Nernst that at the melting-point 1 sq. mm. emitted the same light as 12·1 Hefner candles. We have therefore $\log_e 12{\cdot}1 = 13{\cdot}02 - 13{\cdot}02 \times 2068{\cdot}4/T$ and $T = 2558°$ abs. $= 2285°$ C. Lummer and Pringsheim give as the value for θ, 2073; this gives $t = 2287°$ C., while if we use 12·943 as the value of a, in place of 13·02 we obtain $t = 2289°$ C. The mean of these is 2287° C.

E. C. C. B.

2527. *Arrangement for Reading Deflections.* **J. J. Taudin Chabot.** (Phil. Mag. 8. pp. 111–112, July, 1904.)—Four mirrors are used—one stationary, two revolving, and one on the instrument. Of the revolving mirrors, one is on the axis of revolution and one at the end of a radius, and the axis passes through the instrument mirror. By causing the axial mirror to revolve with n times the velocity of the radial one, optical conjunction of all the mirrors occurs only once in one revolution of the radial mirror, and the deflection angle a of the instrument mirror is thereby increased to $2na$. G. E. A.

2528. *Instruments for Sensitometric Investigations.* **C. E. K. Mees** and **S. E. Sheppard.** (Photographic Journ. 44. pp. 200–223; Discussion, pp. 223–226, July, 1904.)—A description of a series of instruments modified and designed by the authors for determining rapidly the properties of a sensitive plate as a series of sensitometric constants. The instruments described include (1) one for impressing a series of accurately known exposures on a plate; (2) a developing thermostat for developing the plate for a known time at a known temperature; (3) a Hüffner spectrophotometer modified for measuring the densities obtained; and (4) a new machine for coating plates with a very even film of emulsion. The exposure is carried out with an acetylene standard and a Hurter and Driffield wheel. The constants found are (1) the inertia as defined by Hurter and Driffield; (2) the opacity of the unexposed plate to blue-violet light; (3) the greatest possible factor to which a plate can be developed; and (4) the velocity constant of development with decinormal ferrous oxalate at 20° C. To the paper is appended a voluminous bibliography and notes of the discussion which followed. G. E. A.

2529. *Optically Active Carbimides.* **A. Neville** and **R. H. Pickard.** (Chem. Soc., Journ. 85. and 86. pp. 685–690, May, 1904.)—With a view to their use in the resolution of synthetical asymmetric substances, containing hydroxy- or amino-groups, the authors have determined the optical rotation of bornylcarbimide and menthylcarbimide, and of various other derivatives of bornylamine and menthylamine. The velocity with which *l*-menthylcarbimide reacts with alcohols is found to be easily measurable by the change in rotation of the solutions. It is much affected by temperature, by various catalytic agents, by the solvent, and by the constitution of the alcohol. W. H. Si.

2530. *Determination of the Hundred Point of the Ventzke Saccharimeter Scale.* **O. Schönrock.** (Zeitschr. des Vereins der Deutschen Zucker-Industrie, 54. Heft 579. pp. 521–558, 1904. Communication from the Physikalisch-Technische Reichsanstalt.)—The author's results are briefly as follows: The differences in the rotations of sugar solutions obtained by different observers and by the use of different sources of white light vanish when the light is purified by passing through a 1·5 cm. layer of 6 per cent. bichromate solution. A quartz plate of 100° Ventzke rotation gives, with spectrally purified sodium light, a rotation of 34·657° at 20° C. The fact that a substance gives different lights is due to a difference in rotary dispersion between the substance and quartz. The rotation w, corresponding with the hundred point, increases with the temperature, according to the equation: $w_t = w_{20} + w_{20} \times 0{\cdot}000148\,(t - 20)$. The rotation values of the quartz-plates in the saccharimeter are independent of the temperature if the quartz-plates and wedge-compensator have the same temperature. If S_{20} be the rotation of an approximately normal sugar solution at 20° in a saccharimeter at 20° C., and S_t its rotation at $t°$ in the same saccharimeter at $t°$ C., then—

$$S_{20} = S_t + S_t \times 0{\cdot}000609\,(t - 20).$$

The rotation of the normal sugar solution in degrees for spectrally purified sodium light at 20° is 0·010° greater than that of the normal quartz-plate giving a reading of 100° Ventzke at 20° C. In all accurate sugar analyses observation tubes should be used which allow of the introduction of the solution after the two end-plates are in position. The rotation of the normal sugar solution in a saccharimeter with wedge compensation is 0·156° Ventzke greater for the yellow-green mercury light than for sodium light. T. H. P.

2531. *Method of Making the Neutral Layer Visible.* **Hönigsberg.** Zeitschr. Vereines Deutsch. Ing. 48. pp. 867–869, June 4, 1904.)—Bars of glass are bent while transmitting polarised light, advantage being taken of the property that the parts of the bar at which the stress is in the same direction as the plane of polarisation, appear dark when between crossed nicols. The neutral layer appears dark for all positions of the crossed nicols. Interesting photographs given include the cases in which the bars have semicircular and rectangular bends between the points of support, a stress being applied at each side of the bend. G. E. A.

2532. *Fluorescence and Absorption Spectra of Sodium Vapour.* **R. W. Wood** and **J. H. Moore.** (Phil. Mag. 6. pp. 362–374, Sept., 1903. Astrophys. Journ. 18. pp. 94–111, Sept., 1903.)—After a preliminary account of previous work by others, the author describes the apparatus he has used to study the possible relationship between the fluorescent light emitted by sodium vapour and the light absorbed by the same vapour under similar conditions. The chief conclusion is that the fluorescent spectrum coincides absolutely with the absorption spectrum, band for band and line for line. The vapour was produced in a specially constructed tube of steel, so arranged that a supply could be maintained for several hours; the spectra were photographed with a concave grating of 1 m. radius, having 15,000 lines to the inch. Reproductions of some of the resulting photographs are given, which show the close relationship existing between the fluorescent and absorption phenomena. Additional experiments were made with monochromatic illumination of the vapour to determine the relation of the wave-length of the emitted fluorescent light to that of the light absorbed. The absorption spectrum of sodium vapour was photographed in the first order of a concave grating of 14 ft. radius, and the wave-lengths of the maxima of the nine bands obtained are given. In all these bands the absorption decreases from violet to red. Various changes are recorded as being produced by alterations in the density of the vapour under observation. C. P. B.

2533. *Spectrum of Hydrogen.* **L. A. Parsons.** (Astrophys. Journ. 18. pp. 112–128, Sept., 1903.)—After a preliminary review of former research on hydrogen, the author describes the apparatus used and the results obtained in an attempt to determine the conditions governing the various changes in the spectrum. All the gas experimented on was prepared by the electrolysis of dilute sulphuric acid, and every precaution was taken for drying and purifying by passing the gas from the generator through tubes containing calcium chloride, sulphuric acid, caustic potash, potash-lime, and phosphorus pentoxide. Sulphur and gold-foil were employed for the removal of any mercury impurity, and heated copper to absorb the oxygen. The source of electrical power was a storage battery of 4,000 cells, used with a water resistance up to a million ohms. The oscillatory discharge, when required, was obtained by connecting the battery up to a plate condenser, joined through a spark-gap and self-induction coil of 0·009 henry to the vacuum tube. Most of the vacuum tubes were plain cylindrical without capillaries, varying in diam. from 6 to 22 mm. All the observations are described in detail, the chief conclusions being: (1) The compound spectrum never occurs without the four-line spectrum being present, but the four-line spectrum may occur at high pressures without the compound or secondary spectrum. (2) The four-line spectrum is characteristic of an abruptly oscillating discharge, and the compound spectrum, of the continuous discharge from a battery; with the intermediate conditions produced by introducing self-induction into the discharge circuit both spectra are usually present. (3) The four-line spectrum may be produced by high temperature at local points of disruptive discharge along the vacuum tube, but it appears certain that it is not due to the average temperature of the tube being high. (4) It is likely that water vapour may be an important factor with respect to the conduction of the exciting current, but the four-line spectrum is apparently a true hydrogen spectrum. C. P. B.

2534. *Spectrum of Kathodic Light in Nitrogen and Carbon Atmospheres.* **H. Deslandres.** (Comptes Rendus, 137. pp. 457–463, Sept. 14, 1903.)—The spectra shown by the kathodic illumination of various gases have been examined as likely to furnish important evidence in the research on celestial spectra. Vacuum tubes, provided with aluminium poles and closed by plates of quartz, were filled with the gases, including carbonic oxide, carbon-monoxide, and acetylene. In each case comparison spectra were obtained under different pressure conditions, and under the varying intensities produced in the capillary and bulb of the vacuum tube. A long list of the lines observed is given, and part of them are arranged in a series connected by the equation previously used by the author. The important result is obtained that in the ultra-violet spectrum the lines of the negative spectrum are found to be remarkably simple in comparison with the complicated series of doublets, &c., found in the positive spectra. As this appears to hold good for both nitrogen and carbon, it is suggested that similar investigation of other elemental gases is desirable. [See Abstracts Nos. 23 and 30 (1903), and 541 (1904).] C. P. B.

2535. *Unsymmetrical Broadening of Spectral Lines.* **G. W. Walker.** (Phil. Mag. 6. pp. 536–540, Oct., 1903.)—The conditions determining the broadening of a spectrum line are extremely complex and but little known; whatever may be the origin of the broadening, it is nearly always unsymmetrical and generally towards the red, though sometimes the broadening is towards the violet. The author shows that unsymmetrical broadening may be accounted for by the scattering of the light by the negatively charged electrons present in the source. A charged particle under the influence of plane waves can vibrate in a period which differs from the period of the incident waves; a proof is given, and from this it can be seen that, instead of homogeneous light, there will be a portion, scattered by the free charged particles, which will have a longer wave-length than the original light. The intensity of the scattered light will be proportional to the number of free charged particles present in the vicinity of the source; the broadening will increase with the intensity of the original radiations, and the increased breadth will, *cet. par.*, be proportional to λ^3. This theory takes no account of broadening towards the violet; this may, however, be explained as follows: The continual stream of charged particles in the electrical discharge means a local magnetic field of some considerable strength, and thus the phenomena will be complicated by the Zeeman effect. Zeeman noticed a lack of symmetry towards the violet. It may well be that in some cases this cause may be more effective than the other, so that unsymmetrical broadening towards the violet is the result. E. C. C. B.

2536. *Constancy of the Wave-lengths in the Arc and Spark Spectra of Zinc.* **J. M. Eder** and **E. Valenta.** (Akad. Wiss. Wien, Sitz. Ber. 112. 2a. pp. 1291–1304, Oct. and Nov., 1903. Photochem. Laborat. der k.k. Graphischen

Lehr-und Versuchsanstalt, Vienna.)—Exner and Haschek, as well as certain other observers, have stated that the wave-lengths of lines are not necessarily constant, but that they are often different in arc and spark spectra, and further that they vary with the amount of substance present—that is to say, with the partial pressure of the vapour. The authors have put this contention to a rigid test, selecting zinc for their experiments, and after a full investigation they are able to state that the wave-lengths of the lines of this metal at any rate are absolutely constant, whatever be the partial pressure of the vapour, and whether the arc or spark be used. E. C. C. B.

2537. *Spectrum of Silicium.* **G. Eberhard.** (Zeitschr. Wiss. Photog. 1. pp. 346–355, 1903.)—An exhaustive investigation of the spectrum of silicium in the region λ3600–λ4600, under the most varied conditions, based upon plates taken with the spectrograph of the Potsdam Astrophysical Observatory. The effects of varying the method of producing the spectrum are given in a table, the spectrum being observed with (1) the arc between various electrodes and with different pressures, currents, and gaseous atmospheres; (2) with the spark with and without spark-gap, capacity, and self-induction, and supplied by coil and influence machine, as well as in vacuum tubes with SiF_4, $SiCl_4$, $SiBr_4$. The appearance of the Si lines is, in general, favoured by the presence of H (with the exception of λ3905 and λ4103). In almost all cases the lines are wide and diffused, with the two before-mentioned exceptions. Only on reducing the pressure of the surrounding atmosphere was it possible to get the lines as sharp as they appear in some stars. In the region investigated there are few striking features; the chief line is that at λ3905, and auto-reversal was observed of this line alone. The dispersion used was not sufficient to fully examine the band spectrum of SiF_4, which is also described. [See also Abstracts Nos. 1185 (1903) and 2603 (1904).] L. H. W.

2538. *Spectrum of Zinc.* **M. Hamy.** (Comptes Rendus, 138. pp. 959–961, April 18, 1904.)—Certain doubt having been thrown upon the measurements of standard wave-lengths by interference methods owing to a slight difference between the values obtained by the author and by Fabry and Perot, the author gives his determinations of the wave-lengths of certain zinc lines, comparing them with the numbers obtained by Fabry and Perot. They are as follows:—

Hamy.	Fabry and Perot.
6362·346	6362·345
5181·984	—
4810·533	4810·535
—	4722·164
4680·138	4680·138
4629·810	—

There is an excellent agreement between the numbers. The line at λ = 4722 apparently varies in wave-length slightly with changing conditions, probably owing to its being unsymmetrical; its wave-length was not measured for this reason. [See Abstract No. 2536 (1904).] E. C. C. B.

2539. *Magnetic Analysis of Radium Spectrum.* **C. Runge** and **J. Precht.** (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 10. pp. 417–425, Feb. 18, 1904.)—Several of the chief lines in the radium spectrum have been examined under the action of a strong magnetic field, and the results analysed in connection with similar determinations on the spectrum lines of the elements Mg, Ca, Sr, Ba, the intensity of field being about 30,000 c.g.s. A plate is given from a photograph of the line λ5814, showing the six components clearly. Logarithmic curves show an intimate relation in the behaviour of the radium spectrum and those of the above elements. C. P. B.

2540. *Some Additions to the Spark Spectra of the Alkali Metals.* **F. A. Saunders.** (Phys. Rev. 18. pp. 452–454, June, 1904. Abstract of paper read before the Amer. Physical Society, April 22, 1904.)—Lenard, by means of a slitless spectroscope, discovered a new series of lines in the spectrum of sodium [see Abstract No. 588 (1904)]. The author has investigated the spectra of the alkali metals with a concave grating apparatus, which gave the spectra free from astigmatism, and has succeeded in observing Lenard's lines and many new ones. The grating was of 10 cm. width and 305 cm. radius, and was ruled with very long lines on a parabolic surface. The light from the slit was made parallel by a parabolic mirror. This apparatus gave its spectra 150 cm. from the grating along a curve of 75 cm. radius, and the spectra were in very good focus and free from astigmatism. Details are given in the paper of the new lines which were measured. E. C. C. B.

2541. *Study of the Enhanced Lines of Titanium, Iron, and Nickel.* **H. M. Reese.** (Astrophys. Journ. 19. pp. 322–337, June, 1904.)—A photographic comparison of the arc and spark spectra of these three metals carried out by a 10-ft. focus concave grating. The wave-lengths of the enhanced lines were determined with reference to Rowland's standards, and tables are given of the numbers so obtained. A great number of enhanced lines were observed over and beyond those listed by Lockyer in the case of titanium and iron. It is interesting to note that about thirty solar lines not identified by Rowland agree in their wave-lengths with those of lines in the author's lists; it is only reasonable to suppose that the solar lines have their origin in the respective metals. E. C. C. B.

2542. *Extension of Deslandres' Formula for a Band Spectrum.* **H. Nagaoka.** (Mathematical and Physical Soc. Tokyo, 2. 10. pp. 129–131, 1904.)—In this paper the author gives an extension of Deslandres' formula based upon his equations of vibrations in a Saturnian system of negative electrons rotating round a positive central mass. The frequency of transverse vibration is given by $n=\sqrt{S-\mu J}$, where S and μ are constants and $J=\Sigma\frac{\sin^2 h\theta}{\sin^3\theta}, \left(\begin{array}{l} h=1, 2, 3, \ldots \\ \theta=\frac{\pi}{2}, \frac{2\pi}{v}, \ldots \frac{(v-1)\pi}{v}\end{array}\right)$, v denoting the number of electrons. Expressing J as power series of h^2, then

$$n=a_0-a_1h^2+a_2h^4-a_3h^6+\ldots,$$

where $a_0, a_1, a_2, a_3, \ldots > 0$. The form of the function shows that there is crowding of the lines for values of h satisfying the condition $dn/dh=0$. This takes place in the neighbourhood of

$$h=0 \text{ and } h=h_0, \text{ say.}$$

For $h=0$ the head of the band lies in the region of great frequency, and the bands are degraded towards the red; for $h=h_0$ the opposite is the case.

Both types of bands have been observed. In the case of bands of the latter type we may count the lines from head of the band and put

$$h = h_0 - m_1, (m = 0, 1, 2, 3, \&c. \ . \ . \ .).$$

Then by substitution we obtain $n = a + bm^2 + cm^3 + dm^4 + em^5 + . . .$, the term involving the first power of m being entirely absent owing to our counting the line from the head of the band. Using the first five terms, the author has calculated the wave-lengths of 150 lines in the cyanogen band with an extraordinary degree of accuracy. Deslandres' formula contained only the first two terms. The results are given in the following table. The constants used are shown in the equation

$$\frac{10^8}{\lambda} = 2574.964 + 7.1102 \times 10^{-3}m^2 - 6.377 \times 10^{-6}m^3 + 4.613 \times 10^{-8}m^4 - 2.604 \times 10^{-10}m^5.$$

m.	λ (observed).	λ (calculated).	(obs.)-(calc.).
0	3883·55	·55	0·00
10	3882·50	·49	+0·01
20	3879·36	·33	+0·03
30	3874·16	·13	+0·03
40	3866·95	·94	+0·01
50	3857·82	·80	+0·02
60	3846·79	·78	+0·01
70	3833·93	·93	0·00
80	3819·36	·36	0·00
90	3803·16	·15	+0·01
100	3785·42	·42	0·00
110	3766·39	·38	+0·01
120	3746·15	·14	+0·01
130	3724·91	·91	0·00
140	3702·92	·96	−0·04
150	3680·51	·53	−0·02

[See Abstract No. 961 (1904).] E. C. C. B.

2543. *Spectrum of Radium Emanation.* **W. Ramsay and J. N. Collie.** (Roy. Soc., Proc. 73. pp. 470–476, June 22, 1904.)—Since the first observations of the spectrum of helium in the products of the activity of radium, many attempts have been made to obtain a complete record of the spectrum of the emanation itself. Hitherto there has been no continued success, the by-products of the discharge masking the true spectrum desired; the paper describes the method and precautions adopted, so that future workers may be assisted, and a list of the lines observed is given. The quantity of radium bromide experimented on was 109 m.gm.; the chief difficulties checking the observations of the true emanation spectrum were the frequent appearance of the hydrogen secondary spectrum and the alterations of pressure in the vacuum tube. Notwithstanding, the list of fifteen lines is considered to represent the chief lines in the visible spectrum of the emanation. For future reference to the emanation from radium the authors propose that it be designated by the term "exradio." [See Abstracts Nos. 422 (1903), 1531 and 2165 (1904).] C. P. B.

2544. *After-glow of Metallic Vapours in Nitrogen. A New Band Spectrum.* **P. Lewis.** (Astrophys. Journ. 20. pp. 49–57, July, 1904.)—A further investigation into the spectrum of the after-glow in nitrogen previously described [see Abstract No. 1844 (1904)]. This glow is found to occur in the case of chemical nitrogen, dried and purified as far as possible, but which probably contained traces of NO. The after-glow can only be produced by a strong condenser discharge, and shows a discontinuous spectrum consisting of lines and bands. Some of these bands are those of Deslandres' third group of nitrogen, but there are several visible which are yet unidentified. Of the lines some are due to mercury and some to aluminium (from the electrodes), but the others are unidentified. The mercury and aluminium vapours phosphoresce at least 0·1 sec. after the discharge is stopped; these experiments were carried out with a rotating sector working in conjunction with an interrupter, and by altering the period the persistence of the glow could readily be measured. When there is no after-glow in the gas there is no after-glow of the metallic vapours. The mercury lines appear equally well at all pressures, but the aluminium lines are usually stronger at relatively higher pressures. Mercury-sodium amalgam was heated in the vacuum tubes, but the after-glow still persisted, but seemed largely localised in the mercury vapour. It is interesting to note that the sodium lines did not make an appearance even when the tube was highly heated. E. C. C. B.

2545. *Detailed Study of the Line Spectrum of Copper.* **A. S. King.** (Astrophys. Journ. 20. pp. 21–40, July, 1904.)—This important paper contains an account of an investigation into the effect of varying conditions upon the line spectrum of copper as given by the arc and spark. The spectra were photographically examined between the limits $\lambda = 5800$ and $\lambda = 2200$, care being taken in comparing the relative intensities of the lines to refer all the plates to a chosen standard. One line $\lambda = 4651$ was selected, as this line was but slightly changed under the various conditions employed, and all the plates were exposed and developed so that this line had as far as possible an equal intensity on each; if not, this line was given the standard value and the values for the other lines changed in proportion. Amongst many effects of varying conditions the following are the most important. When a weak and constantly interrupted arc is employed between copper poles certain lines are enhanced. These lines occur in the spark and are favoured by the conditions obtaining in strong sparks; they are decreased in intensity by self-induction and by hot electrodes. Since these lines are enhanced by the interrupted arc it is probable that they are due to oscillatory discharges. An important change was also observed when the outer portion of the middle of a long arc was compared with the part nearest the electrodes. A group of lines was observed which were much reduced under the former condition. This group contained lines belonging to the class last described, and the author attributes them also to oscillations in the arc. As regards the spark spectrum, an interesting point observed is that very slight alterations are produced by altering the strength and length of the spark. The spectra given with self-induction, hot electrodes, or at the centre of long sparks are strikingly similar to one another. The spark lines are divided by the author into three groups. In Group I. are placed those lines which occur only in the spark and also some lines the behaviour of which in the spark, while they also appear in the arc, indicates that they are especially favoured by the conditions of the strong spark. They are much reduced by self-induction, hot electrodes, and usually by atmospheres of hydrogen and oxygen. The latter group of lines in the arc are greatly reduced by the weak continuous arc and restored almost, if not quite, to full value by the interrupted arc. Groups II. and III. consist of lines common to arc and spark but not easily assignable to any one condition as sole cause. The lines of Group II. are much reduced by self-induction; they are reduced by weak continuous arcs, and appear with considerable strength in the spark with hot electrodes. Probably vapour density governs the intensity of these lines. Group III. contains the remaining lines which are little altered by self-induction, hot electrodes, or the middle of a long spark. They are of all the lines the least affected by changing the conditions of the arc. Finally, the affect of altering the surrounding atmosphere was tried. Very considerable differences were observed in the relative intensities when atmospheres of hydrogen or oxygen were employed; these differences are given together with those observed throughout the investigation, in a table. The author points out that there is a great field for investigation on these lines, and that these experiments can only be looked upon as a beginning in this direction.

E. C. C. B.

2546. *Correction of the Standards of Wave-lengths.* **J. Hartmann.** (Astrophys. Journ. 20. pp. 41–48, July, 1904.)—As a result of the discovery that certain inaccuracies are to be found in Rowland's tables of wave-lengths, and also that the coincidence method with concave gratings is untrustworthy, the question at once arises as to the choice of new standards. It is of course necessary that first of all a truly correct relative system be obtained. Then the question arises as to whether the standards should be shifted over to Michelson's cadmium value or remain as at present referred to Bell's sodium value. The author strongly maintains that it would be useless to shift to Michelson's standard, since no one can possibly expect this to be final. His suggestion is as follows: Let the wave-length of the red line of cadmium in vacuo be adopted as $\lambda = 6438{\cdot}6911$ as the invariable fundamental for all time, and let a system of iron standards be prepared as uniform as possible by means of grating measurements. In a previous paper the author has given a table of corrections to Kayser's normals in the iron spectrum; these normals must now be extended. [See Abstract No. 1409 (1904).] Kayser himself strongly favours the change to Michelson cadmium value. [The author in his paper remarks that the Fabry and Perot standards may be erroneous by a considerable random amount, and this appears to be his objection to the change to the Michelson standard, as well as of course the great labour involved. There cannot be any doubt that the Michelson-Fabry-Perot values are very much nearer the truth than the Bell-Rowland values, and whether we may in years to come get nearer to the actual truth or no, this is surely a very strong argument in favour of the change. Perhaps the strongest argument of all is to be found in the weakness of the grating as a dispersing apparatus; Hartmann recommends the calculation of a system of true standards from grating measurements. These grating measurements must be by interpolation only, and therefore can only be done from interference standards; as the latter must be reduced by a factor before this can be carried out it is better to adopt the interference standards once and for all. They are not subject to any more likelihood of random error than interpolation grating measurements. Finally, we are not absolutely certain of the grating even for interpolation measurements.] E. C. C. B.

2547. *Ultra-violet Absorption Spectra of Certain Enol-keto-tautomerides.* Part I. *Acetylacetone and Ethyl Acetoacetate.* **E. C. C. Baly** and **C. H.**

Desch. (Chem. Soc., Journ. 85. and 86. pp. 1029–1041, July, 1904.)—For the purpose of deciding as to the constitution of acetylacetone, ethyl acetoacetate and their metallic derivatives, the authors have determined their absorption spectra. It was found that acetylacetone itself and its beryllium, aluminium, and thorium compounds all show a well-marked absorption band, and that the absorption curves have all very much the same shape. Since Perkin has shown that acetylacetone probably consists of a mixture of 70 per cent. of the di-enolic, with 30 per cent. of the mono-enolic modification, the authors conclude that the metallic derivatives are also enolic in constitution, and that the metal is attached to oxygen. In the case of ethyl acetoacetate, a small general absorption, with no trace of a band, was obtained; while its aluminium derivative gave a strong banded absorption, almost identical with the acetylacetone spectra. This points to the ethyl acetoacetate being ketonic, while the aluminium compound is enolic in structure. In accordance with this is the fact that the specimen of ethyl acetoacetate gave a colouration with ferric chloride which developed extremely slowly, while acetylacetone gave a strong colouration immediately. As to the reason for the absorption band, the authors find that neither a purely enolic form ($CH_3 . C(OEt) : CH . COOEt$) nor a purely ketonic form ($CH_3 . CO . CHEt . COOEt$), nor a mixture of these, gives an absorption band, and they conclude that the absorption band is due to the vibration connected with the change from the one modification to the other. This view received confirmation from a study of the effect of addition of caustic soda and of hydrochloric acid to ethyl acetoacetate. Since the isomeric change is accelerated by the former and restrained by the latter, the addition of caustic soda should cause the appearance of a band, the persistence or length of which should depend directly on the quantity of caustic soda added. This was found to be the case. The opposite effect—the diminution of the absorption by hydrochloric acid—was also found in the case of ethyl acetoacetate, but better in the case of ethyl β-aminocrotonate.

A. F.

2548. *Determination of Small Quantities of Carbon Monoxide in Air by Spectro-photometry.* **L. de Saint-Martin.** (Comptes Rendus, 139. pp. 46–49, July 4, 1904.)—When diluted dog's blood showing 0·15 per cent. of oxyhæmoglobin is shaken with air containing from 0·02 to 0·1 per cent. of carbon monoxide, a certain amount of this gas is absorbed forming carbonic oxide hæmoglobin, the amount formed depending upon the original concentration of the carbon monoxide. From a series of quantitative experiments a curve is drawn showing the relation between the CO concentration and the resulting ratio H_{CO}/H_O, where H_{CO} is the carbonic oxide hæmoglobin produced and H_O is the original oxyhæmoglobin; this ratio is measured in a spectrophotometer. By means of this curve it is possible at any time to determine the amount of CO in a sample of air. It is important that dog's blood be used, as in other cases the carbonic oxide hæmoglobin is too unstable.

E. C. C. B.

2549. *Spark Spectrum of Silicium.* **A. de Gramont.** (Comptes Rendus, 139. pp. 188–191, July 18, 1904.)—The effect of introducing various amounts of self-induction in a spark circuit with silicium poles has been investigated, with special reference to the importance which has been ascribed to the silicium lines as furnishing criteria for the estimation of stellar temperatures. The spectra were produced by means of a spectrograph with quartz lenses of 40 cm. focus, both quartz and calcite prisms being used for the violet regions, and for the other region a compound Rutherford prism. The spark was obtained from a 15-cm. spark coil, with 0·009 microfarad in the secondary circuit. Comparison spectra were photographed under successive increments of induction of 0·00002 up to 0·03 henry. The silicium has been used in the form of pure octahedral or lamellar crystals, or as silicate of sodium fused on platinum. Wave-lengths were determined by comparisons with the spectrum of a cadmium-lead alloy. Tabulating the lines found, their comparison with the values given by other workers are indicated, chiefly with reference to the division of the lines into four groups by Lockyer, who suggested their applicability to the study of stellar temperatures. With regard to one group, however, the author differs from the conclusion of Lockyer as to its indicating the true presence of silicium in stars of relatively high temperature. From the behaviour of these lines (Group IV.) under the influence of self-induction he thinks they are probably due to air. [See Abstracts Nos. 1845 (1902) and 2603 (1904).] C. P. B.

2550. *Action of Fluorescent Substances on Ferments and Toxins.* **H. v. Tappeiner.** (Ber. Deut. Chem. Gesell. 36. pp. 3035–3038, 1903.)—The author and Raab have previously shown that the poisonous action of fluorescent substances on infusoria is enormously intensified by the influence of light (Münch. Med. Woch., 1900, 1). The effect of fluorescent substances on enzymes and toxins has accordingly been studied. When eosin is present and when the solution is exposed to ordinary daylight, the conversion of starch into maltose by means of diastase is considerably retarded. In the dark, eosin does not retard the formation of maltose, nor was the observed retarding effect due to the action of daylight alone. Experiments with other substances are described. Apparently only those fluorescent substances act, the light absorption of which lies in the green or light blue part of the spectrum. The effect is quite marked even when eosin, in the proportion of 1 : 400,000, is used. The behaviour with invertin was analogous to that with diastase. When a solution containing ricin and a little eosin is exposed for 14 hours to diffused daylight, the ricin loses its characteristic property of coagulating red blood corpuscles ; a solution containing ricin, in the absence of eosin, was unaltered in diffused daylight, whilst a solution containing both ricin and eosin was unaltered in the dark. Experiments on guinea-pigs proved that the poisonous effect of a solution containing both eosin and ricin, which had been exposed to light, was less than that of a similar solution which had been kept in the dark. L. H. W.

2551. *Diffraction Images formed by a Plane Diffraction Grating.* **A. W. Porter.** (Phil. Mag. 8. pp. 174–178, Aug., 1904. Paper read before the University College Mathematical Society.)—An ideal grating is considered with alternate opaque and transparent strips with the incident light normal to the surface. The intensity of the image formed at the focus of the telescope (adjusted for parallel rays) is given by

$$y^2 = F_1^2 F_2^2 = \left(\frac{\sin u}{u} \cdot \frac{\sin nv}{\sin v}\right),$$

where $n =$ number of transparent strips, $u = \frac{\pi}{\lambda} r \sin\theta$, $v = \frac{\pi}{\lambda}(r + s)\sin\theta$, $\theta =$ direction of observation, and r and s the widths of transparent and opaque strips respectively. Now the positions of the maxima and minima are usually found by equating to zero the first differential coefficient of F_2^2 with regard to v. This coefficient is as follows :—

$$\frac{dF_2^2}{dv} = 2\frac{\sin nv}{\sin v}\left(\frac{n \cos nv \sin v - \sin nv \cos v}{\sin^2 v}\right).$$

The principal maxima are given by $\sin v = 0$, which is generally supposed to make the coefficient discontinuous ; further, the secondary maxima are said to be given by the equation $\tan nv = n \tan v$, and the secondary minima by $\sin nv = 0$ (unless $\sin v = 0$). The author points out that $\sin v = 0$ makes the coefficient zero, and that the conditions for secondary maxima and minima are incomplete. Taking the case of the secondary maxima, when n is odd, the condition $\tan nv = n \tan v$ is incomplete since it does not include the maximum midway between two principal maxima. Thus when $n = 3$, although there is a secondary maximum whenever $v =$ an odd multiple of $\pi/2$, yet there is no value of v satisfying the equation $3 \tan v = \tan 3v$, except even multiples of $\pi/2$, which give the principal maxima. The author points out that the differential coefficient also vanishes when $\cos nv$ and $\cos v$ are simultaneously zero, and that this is the condition for the maximum unaccounted for by the condition given above. The conditions may be more neatly stated if the differential coefficient be written in one of the following forms :—

$$\frac{dF_2^2}{dv} = 2\frac{\sin nv}{\sin^3 v}\left\{(n-1)\sin(n+1)v - (n+1)\sin(n-1)v\right\}$$

$$= 2\frac{\sin^2 nv}{\sin^2 v}\left\{n \cot nv - \cot v\right\}.$$

The coefficient vanishes whenever $(n-1)\sin(n+1)v - (n+1)\sin(n-1)v = 0$, or when $n \cot nv - \cot v = 0$. Both of these conditions give all the maxima. Again, when $\sin v = 0$, the differential coefficient becomes zero and not discontinuous. The approximate value when v approaches an integral multiple of π is $2n^2(1 - n^2)\alpha/3$, where $\alpha = v - p\pi$, p being an integer. This obviously vanishes when $\alpha = 0$; since $n^2 > 1$, it is positive when $\alpha =$ negative, and negative when α is positive ; the vanishing of α thus corresponds to a maximum of F_2^2. The author next deals with the relative intensity of the principal and secondary maxima, about which some misconception exists. The secondary maxima are given by those values of v for which $\cot nv = \cot v/n$, and therefore $\sin^2 nv = n^2/(n^2 + \cot^2 v)$. The intensity is therefore

$$F_2^2 = \frac{\sin^2 nv}{\sin^2 v} = \frac{n^2}{n^2 \sin^2 v + \cos^2 v} = \frac{n^2}{1 + (n^2 - 1)\sin^2 v}.$$

The ratios of secondary to principal intensities are given for the case of the secondary maxima nearest to the principal maxima, and they never are less than $\frac{1}{21{\cdot}2}$, even when $n = \infty$. Finally, the precise position of the principal maxima is discussed ; the maxima usually considered are the maxima of F_2^2, while the maxima of y^2 are really required. The error introduced is calculated, and is found to be far below the least detectable error provided n is large and the maximum considered is fairly bright. [The author discusses the reason why the secondary maxima are invisible with an ordinary grating, and attributes it to the fact that the principal maxima are in reality very feeble. This, however, does not seem a sufficient explanation as it is quite possible to observe spectrum lines one-hundredth of the intensity of the ordinary bright spectrum lines.] E. C. C. B.

2552. *Atomic Weight of Radium, and Relationships between Atomic Weights of Elements and their Spectra.* **W. M. Watts.** (Phil. Mag. 8. pp. 279–284, Aug., 1904.)—In a previous paper [see Abstract No. 1182 (1903)] the author gave some relationships between the spectra and atomic weights of the elements and showed how the latter may in some cases be calculated from the atomic weights of elements in the same family. This has been criticised by Runge, and the author now upholds that his relationships are certainly true in many cases, proving this by examples. His second law, that the difference in oscillation frequency of homologous doublets is proportional to the square of the atomic weights, is certainly true for zinc and cadmium, but in other cases the power may not be exactly the square. Thus for copper and silver the power is 2·4765, for magnesium, calcium, strontium, and barium it is 1·16214, &c. Runge and Precht's law, which they used in the case of radium, is really the same thing, namely, that the difference is proportional to the atomic weight raised to the power 5/3. By means of examples the author shows that for the higher members this rule tends to give too high values for the atomic weights, and he, therefore, views Runge and Precht's value, 258, with suspicion. [See also Abstract No. 1641 (1904).] E. C. C. B.

2553. *Fluorescence. V. The Benzene Ring-System.* **H. Kauffmann** and **A. Beisswenger.** (Ber. Deut. Chem. Gesell. 37. pp. 2612–2617, 1904.)—The following table shows how the fluorescence and colour of 3-aminophthalimide varies with the solvent, but is not directly related to the dispersion (Kundt's rule):—

	Fluorescence.	Colour.	Dispersion of Solvent.
Water	green	yellow	326
Acetic acid	↓	│	374
Alcohol (absolute)	blue-green	│	330
*iso*Butyl alcohol	│	│	378
Pyridine	│	│	—
Amylene	↓	↓	461
Chloroform	blue	pale yellow	—
Acetone	│	│	388
Anisole	↓	│	1086
Thiophen	blue-violet	│	1086
Ether (absolute)	↓	↓	351
Benzene	violet	colourless	1056

This change is characteristic of all fluorescent, and also appears in the non-fluorescent amines, and is not hindered by substituting alkyl or aryl groups. As the molecular weight is normal even in associating solvents, the conclusion is drawn that the change of colour is not due to reversible isomeric or polymeric change, but rather to the distortion of the benzene ring-system. T. M. L.

2554. *Effect of Light upon the Absorption and the Electrical Conductivity of Fluorescent Solutions.* **E. L. Nichols** and **E. Merritt.** (Phys. Rev. 18. pp. 447–449, June, 1904. Abstract of paper presented at the Washington Meeting of the Amer. Physical Society, April 22, 1904.)—An investigation into the change of absorptive power and electrical conductivity of fluorescent bodies when caused to fluoresce. Fluorescein was employed in one set of experiments and its absorptive power was spectrophotometrically determined both under ordinary circumstances and when fluorescence was caused by a second light-beam. It was found that the effect of fluorescence was to introduce a new and well-defined band into the absorption spectrum of the solution, the extent of this band being approximately that of the spectrum of the fluorescent light. In the case of a rather dilute solution the maximum increase of absorption occurred at $\lambda = 5070$. When fluorescence was excited by a group of four acetylene burners the increase in absorption at this point amounted to 67 per cent. In a more concentrated solution the region of greatest increase in absorption lies further towards the red and coincides with the edge of the normal absorption band. The percentage absorption due to fluorescence was found to be a function of the intensity of the incident light, being greatest when the intensity of the incident light was least. In the case of the electrical conductivity of fluorescent solutions it was found that a small but perfectly definite increase in conductivity took place when the solutions were illuminated. [See also next Abstract.] E. C. C. B.

2555. *Luminescence.* **E. L. Nichols** and **E. Merritt.** (Phys. Rev. 19. pp. 18–36, July, 1904.)—For the author's earlier experiments on this subject see preceding Abstract. The present paper gives the results of further experiments on the subject, consisting of spectrophotometric measurements of other fluorescent substances than those already examined. The authors have determined in each case by means of the spectrophotometer the location and character of the absorption band with which fluorescence is associated, and the form of the curve of relative intensities in the fluorescence spectrum. In all the substances examined this spectrum consists of a single band situated near the infra-edge of the absorption band with which fluorescence is associated, and the position of the maximum of the fluorescence band, and the distribution of intensities, are independent of the wave-length or composition of the exciting light. Stokes' law holds for none of the substances examined. Fluorescent substances may have absorption bands of greater wave-length than that with which fluorescence is associated, but the light absorbed in these bands does not produce fluorescence as is the case where substances have bands of shorter wave-length than that with which fluorescence is associated. Where more than one fluorescence band exists, as in the case of chlorophyll, the authors think it possible that each band is due to a distinct fluorescent substance in the solution. No case of double or multiple fluorescence has been found where only one substance capable of fluorescence is present. W. C. H.

2556. *Radio-active Gas in Cambridge Tap-water.* **Thomson.** (Cambridge Phil. Soc., Proc. 12. pp. 172–174, Oct., 1903.)—When Cambridge tap-water is boiled the air given off is mixed with a radio-active gas. From diffusion experiments indications of the presence of two different gases are obtained, one having a density about twice, the other between six and seven times that of CO_2. A negatively electrified surface exposed to the gas becomes radio-active, a positively electrified surface becomes so to a smaller extent, while an unelectrified surface does not become radio-active. The gas in this respect differs from the emanation from radium. The radio-active gas is much more easily liquefied than air. No new lines were detected in the spectrum of the gas, those present being mainly due to hydrocarbons. [See also Abstract No. 1364 (1904).] J. J. S.

2557. *Possible Correlation of Luminous Phenomena with Radio-activity.* **H. E. Armstrong** and **T. M. Lowry.** (Roy. Soc., Proc. 72. pp. 258–264, Oct. 19, 1903.)—Tribo-luminescence is observed in the cases of three derivatives of camphor capable of existing in isodynamic forms, but not in those derivatives which cannot so exist, *e.g.*, α-chloro-, α-bromo-camphor. It may be considered as the outcome of a loss of potential consequent on the passage from an unstable to a stable system. Fluorescence and phosphorescence are treated from the same point of view, and radio-activity is classed with these phenomena as but an exaggerated form of fluorescence, this view being, to the chemist, "at least as rational as the one which assumes that nature has endowed radium alone of all the elements with incurable suicidal monomania." It is pointed out that uranium nitrate, for instance, is not only radio-active, but tribo-luminescent, fluorescent, and phosphorescent at low temperatures. It is, therefore, by no means improbable that the several manifestations all have their origin in the formation and decay of isodynamic or equivalent systems. G. E. A.

2558. *Production of Helium from Radium.* **W. Ramsay** and **F. Soddy.** (Roy. Soc., Proc. 73. pp. 346–358, May 28, 1904. Zeitschr. Phys. Chem. 48. pp. 682–696, July 12, 1904. Phys. Zeitschr. 5. pp. 349–356, July 1, 1904.)—The paper describes the continuation of the research undertaken with the object of ascertaining the volume of emanation produced in a given time from a given weight of radium bromide, and also the quantity of resulting helium collected. The values found are extremely small, and the determinations involved repeated separations from minute quantities of nitrogen occurring as impurities. It was concluded that 1 gm. of radium produced 3×10^{-6} cub. mm. of emanation per sec. [See Abstract No. 2165 (1904).] C. P. B.

2559. *Peculiar Photographic Action.* **J. Blaas** and **P. Czermak.** (Phys. Zeitschr. 5. pp. 363–368, July 1, 1904.)—White paper was written upon with a solution of uranium salt and then exposed to the sun; it was afterwards placed in the dark for 24 hours upon a photographic plate. On developing the plate a negative appeared instead of the expected positive of the writing. The paper exposed to the sun had also produced blackening on the plate. White paper kept in the dark for some weeks and then exposed to the sun produces blackening of a photographic plate, writing made upon it before or after the exposure to sunlight appears on the photographic plate bright upon a dark ground. Very many substances were found to obtain by strong exposure of their surface to the sun the property of blackening photographic plates. This peculiarity is connected with an occlusion of ozone. Bright or amalgamated zinc possesses the peculiarity spontaneously, and shows it strongly if it is covered with a very thin layer of glycerine and then with a powder such as soot. Here also the presence of ozone is shown. The various substances investigated (such as paper of different sorts, wood, straw, shellac, and inorganic mineral bodies) send out a diffuse radiation which belongs to the blue end of the spectrum, and is reflected at mirror-like surfaces. J. J. S.

2560. *Atmospheric Radio-activity.* **H. A. Bumstead.** (Amer. Journ. Sci. 18. pp. 1–11, July, 1904. Phys. Zeitschr. 5. pp. 504–509, Aug. 15, 1904.)—Experiments were made on an exposed wire kept at a constant negative potential, and afterwards tested by means of a sensitive electrometer. From these it is concluded that the radio-activity acquired (as observed in New Haven, Conn.), is mainly, if not wholly, due to the excited activities of radium and thorium. With a three-hour exposure in the open air, 3 to 5 per cent. of the total initial effect is due to the thorium activity, the proportion depending apparently upon the greater or less ease with which the emanations escape from the soil. With a twelve-hour exposure the thorium activity is sometimes 15 per cent. of the whole, and with a long wire its decay may be followed for several days. There is some evidence that a small quantity of a more rapidly decaying activity is present in addition, but the experiments do not definitely establish this. The radio-activity of rain and snow is probably due to radium-excited activity, the absence of the thorium effect being accounted for by the fact that the rapid decay of the thorium emanation prevents its reaching, in appreciable quantities, the height at which the rain-drops are formed. J. J. S.

2561. *The Radio-active Substance in "Fango."* **F. Müller.** (Phys. Zeitschr. 5. pp. 357–363, July 1, 1904.)—The observations of Elster and Geitel on the radio-active properties of the earth called Fango were repeated with larger quantities. A large amount of Fango was placed in a cellar, and an increase of the conductivity of the air beyond that which was to be expected in this cellar was noticed. A strongly increased conductivity in the air drawn directly out of the layer of Fango was observed. The induced radio-activity from the emanation produced by the Fango could be shown. Its curve of decay resembled that of radium. J. J. S.

2562. *The Penetrating Radium Rays.* **J. A. McClelland.** (Phil. Mag. 8. pp. 67–77, July, 1904. Paper read before the Royal Dublin Soc., April 19, 1904.) —The author seeks to determine whether the rays carry a charge. A sample of radium is placed at the bottom of a hole in a block of lead which is insulated. When α-, β-, and γ-rays are allowed to escape the block gains a negative charge. Since the β-rays are only produced in the final stages of disintegration, we should expect the negative electricity carried away by them to be less than the positive carried away by the α-rays. The hole is next covered with foil thick enough to stop the α-rays, and, as might be expected, a positive charge results. By closing the hole with a thick piece of lead the γ-rays only escape; the block then gets a negative charge. This is shown to be due to the diffusion of negative ions from the surrounding air. A more conclusive experiment is as follows: The vessel whose charge is tested is surrounded by a larger one, and the space between is filled with wax so as to exclude diffusion from one to the other. The inner vessel is filled with lead shot, which absorb the γ-rays from radium placed outside both vessels, and screened so as to exclude α- and β-rays. It is concluded that the charge, if any, carried by γ-rays is not more than 1 or 2 per cent. of the negative electricity carried by the β-rays. The absorption of the rays is also studied by a similar apparatus, and is found not to follow the law expressed by $I = I_0 e^{-\lambda x}$. It is found that λ diminishes with the thickness of substance traversed. Numbers are given, showing that the law that the coefficient of absorption is proportional to the density is not followed except for the most penetrating kind of γ-rays. Eve has shown that this is probably true for the most penetrating Röntgen rays. Finally, experiments of Paschen on the same subject are alluded to, and it is shown, contrary to the opinion of their author, that they may be interpreted as proving that γ-rays are of the nature of Röntgen rays. R. S. W

2563. *Radio-active Lead, Radio-Tellurium, and Polonium.* **A. Debierne.** (Comptes Rendus, 139. pp. 281–283, July 25, 1904. Chem. News, 90. p. 92. Aug. 19, 1904.)—Polonium has the following characteristics: Its solutions are precipitated by hydrogen sulphide in the presence of an acid, and it follows bismuth in different chemical reactions. Its radiation is clearly distinct from those of uranium, thorium, radium, and actinium, and consists of α-rays only. Polonium gives no emanation and does not cause induced radio-activity. Two other radio-active substances precipitated by hydrogen sulphide in acid solution have been recorded—*radio-active lead*, described by Hofman and Strauss, and *radio-tellurium*, investigated by Marckwald. The author, having a large quantity of residues obtained in the extraction of radium, has tried to get the substance of Hofmann and Strauss. He describes the chemical method of obtaining it, and finds it to be highly radio-active. In the experiments it manifested successively the properties of radio-active lead, polonium, and radio-tellurium. The conclusion is that a distinction should not be made between these three substances, that there exists in pitchblende only one substance precipitated by hydrogen sulphide in acid solution, and that it should keep the name *polonium* originally given to it by P. and Mme. Curie. On account of the small quantities present in the minerals, chemical reactions are uncertain, and the only sure way of characterising a radio-active substance is by the nature of its radio-activity. The identity of the radiations from polonium, radio-tellurium, and radio-active lead indicated beforehand the result now established by chemical methods. The radio-active lead used in the researches has preserved its radio-activity during many years, while in the specimens of polonium used in the first researches this activity gradually disappeared. The constancy of activity may then depend on exterior conditions, which it will be very important to determine. J. J. S.

2564. *Photographic Registration of* N*-ray Effects.* **R. Blondlot.** (Comptes Rendus, 138. pp. 1675–1676, June 27, 1904.)—Details as to methods of recording brightening of electric sparks under the action of *n*-rays. The spark is most sensitive when the points are separated until the brightness is just past its maximum. Slow development brings out the differential effect very clearly. [See Abstract No. 1048 (1904.)] A. D.

2565. *Heavy Emanations.* **R. Blondlot.** (Comptes Rendus, 138. pp. 1473–1476, June 13; pp. 1676–1679, June 27; and 139. pp. 22–23, July 4, 1904.)—A screen of calcium sulphide rendered phosphorescent by sunshine becomes brighter if a silver coin be held directly *above* it, but not if the coin be held below it. The patch which brightens up corresponds precisely to such an area of impact as would present itself if the coin shot off, at right angles to its surface, emanations the path of which was deflected (if oblique) by gravity. Phenomena of rising or falling jets in a resisting medium (air), or of the impact of two jets, may be repeated with precision. The invisible jets traverse paper, cardboard, or 2 cm. of wood, but are reflected by glass. Copper, zinc, lead, and wet cardboard act like silver; gold, platinum, glass, and dry cardboard do not. Magnetic forces deviate these heavy emissions, as if the coin emitted particles not charged, particles negatively charged, and particles positively charged, for there are three distinct trains of emanations producing three patches on the screen, which are oppositely displaced by rubbed resin and by rubbed glass. Currents of air displace these heavy emanations, which also encounter resistance in the air. The heavy emanations act on a small electric spark in the same way as *n*-rays do, and the effect can be photographically recorded in the same way. If the silver coin used be mechanically cleaned, the emanations cease, to resume if the coin be heated in the air to 100° C. and cooled down. Cu, Fe, Hg, Zn, and coinage bronze all act in the same way; lead always emits unless it is tarnished by exposure to the air. All liquids tested have proved active, particularly those which have an odour. Inactive substances are Pt, Ir, Au, dry glass, melted sulphur, plaster-of-Paris, and chalk. Possibly these emanations are due to feeble chemical combinations going on at the surfaces of the apparently active substances. A. D.

2566. *Comparison of Effects of β- and N- and of α- and N_1-rays on a Phosphorescent Screen.* **J. Becquerel.** (Comptes Rendus, 139. pp. 40-42, July 4, 1904.)—The property of β-rays from a radio-active body, of increasing the brightness of a screen viewed normally to the surface has already been shown [see Abstract No. 1660 (1904)], but if the screen is looked at through a flask of distilled water the change of brightness is absent. Under the β-rays, as under the *n*-rays, the screen emits secondary radiations which accompany the luminous rays as far as the retina and produce an increased sense of vision [see Abstract No. 1652 (1904)], and an experiment directly confirming this is described. The effects of some polonium-bearing bismuth oxide (of activity 60 about) were also examined. In this case it was found that (1) a diminution of luminosity is caused by the salt when brought near the screen; (2) the radiation is arrested by glass or by a sheet of paper; (3) when the α-radiation is stopped in this way, the salt brought near the screen produces an increase of luminosity, due to the more penetrating rays, which may be either the γ-rays of polonium or the secondary rays caused by these, or they may be *n*-rays given out by the substance. Looked at through a flask filled with pure water, the effect of bringing the unshielded salt very near the screen is to produce a somewhat greater increase of luminosity. With salt water the effect is the same as in (1)—as though no salt water were there. This is considered to show that the screen under the α-rays gives out n_1-rays normal to its surface. L. H. W.

2567. *Stationary Waves Observed in the Neighbourhood of the Human Body.* **A. Charpentier.** (Comptes Rendus, 139. pp. 155-157, July 11, 1904.)—In a sealed note deposited on Jan. 10, 1904, the author had described the fact observed by him that stationary waves exist in the neighbourhood of the human body, of mean length about 3·5 cm., such waves passing through both moist paper and sheet lead, and maxima and minima were observed. These observations have since been confirmed by other experiments in which a slab of marble, kept in a dark room till all the absorbed *n*-rays had disappeared, was placed in front of the body and the latter gradually moved away from the slab. The maxima were found to be more distinct on some days than on others, up to 14 being once recognised within 52 cm. from the body. The most remarkable point is that the interval between the maxima corresponds exactly to the mean wave-length of the nervous oscillations previously referred to. [See Abstracts Nos. 1937 and 1943 (1904).] A similar effect was also noticed when the retinal oscillations already known were examined in the same manner, successive maxima being found at 2 mm. intervals about. Other sources of *n*-rays, such as a blade of steel or a sulphide screen, were also found to give rise to series of aerial maxima. The author does not attempt to explain the phenomenon. L. H. W.

2568. *The Human Body and Blondlot's Heavy Emanations.* **J. Meyer.** (Comptes Rendus, 139. pp. 320-322, July 25, 1904.)—The eyes themselves give off these emanations in several jets. Jets flow from the finger-tips, at first in straight lines, then falling towards the ground. They traverse paper, card, wood to 10 cm., zinc to 1 cm., but not lead of 1 mm. thickness, wet paper, or glass. They travel down a glass tube as by repeated reflexion, even a tube bent to several obtuse angles, so long as the tube descends. The heavy emanations from the eye or from the hand can be collected in a glass flask by a few minutes' exposure, and can be poured on to a phosphorescent screen which will become brighter. The contents of the flask will not all pour out, but may be shaken out. The jet is deviated by the magnet. [See Abstract No. 2565 (1904).] A. D.

2569. *Variations of Luminosity of Phosphorescent Sulphides under Action of* N-*rays*. **E. Bichat.** (Comptes Rendus, 139. pp. 254–256, July 25, 1904.)—The actions which can be observed with a phosphorescent screen are shown by the author, by the aid of numerous experiments, to be capable of being modified according to the condition of the source and the observer, and it is pointed out that it is neccessary to place oneself under certain well-defined conditions to observe the action of *n* and similar rays on phosphorescent substances. It is thus shown that the radiation from an incandescent platinum wire, heated by an accumulator, received through a sheet of aluminium, producing an increase of luminosity of the screen, can be made to produce a decrease of luminosity if the accumulator (and the wire) be insulated. The original effect is reproduced if the platinum wire be earthed by an unoxidised copper wire; with an oxidised wire this transformation will not take place. If the radiation from a Nernst lamp is received by a piece of wet cardboard having an opening in it, and then by a prism of aluminium, a band spectrum can be observed by moving the screen along normal to the direction of the beam, the bands being shown by maxima or minima of brightness according as the wires supplying current to the lamp are or are not oxidised. If, for instance, an increase of luminosity is observed in any case, this can be converted into an apparent minimum if the observer takes hold of one pole of a battery, the other pole of which is earthed. (The wire must be pressed between the fingers, not mere contact.) Again, if the observer who notices an increase of brightness is insulated (on a glass-legged stool), if he then be electrified either positively or negatively, by means of a stick of resin or rod of glass, the maximum of brightness is converted into a minimum. Finally, an experiment is described in which a coin, fixed in a support, emitting a heavy emanation according to Blondlot, produces an increase of brightness where the emitted material jet meets the screen. On insulating the coin a minimum of brightness is seen where formerly a maximum was observed. This minimum is again changed into a maximum if the coin be touched by an earthed wire or if the observer, being insulated, be electrified. L. H. W.

2570. *Photometry of* N-*rays*. **F. E. Hackett.** (Roy. Dublin Soc., Trans. 8. 10. pp. 127–138, Sept., 1904.)—The author is one of the few who have been able to confirm Blondlot's results as to the increase of brightness produced or observed on a phosphorescent screen under the influence of the *n*-rays. The paper begins by pointing out that it is useless to expect to see the effects with a brightly phosphorescent screen—at least, without special training; a very dim screen must be used, the main use of the screen being to provide a dimly-lighted surface. The mere remembering a definite brightness would be very difficult, but the method of distinguishing an outline which becomes more distinct on increase of brightness is a more definite method. The experiments are then very fully described for the purpose of enabling others to be able to see and measure these effects. The object generally used was a diaphragm with two vertical slits, held in front of a phosphorescent screen, the slits being separated by a distance equal to their own width (2–3 mm.). At a short distance the two slits appeared distinct, separated by a black line. On moving the screen away from the eye, the black interval gets more indistinct and finally disappears, the two slits then appearing as a single spot of light. Just before this condition is reached, the screen is at its sensitive condition, a slight increase of brightness causing the line between the slits to reappear. If I represent intrinsic brightness and R = distance of screen from observer, it was found that under the same conditions of indistinctness the law $\frac{I}{R^2}$ = a const., was roughly followed by the experiments. The variation of sensitiveness over the area of the retina is next dealt with, and "isolumes," as suggested by Abney, are drawn (lines of equi-sensitiveness) for the dark-adapted retina. A formula for the measurement of brightness is then derived, in which, assuming the law of inverse squares, the apparent increase of brightness for small changes is = twice the distance the screen is moved forward (till slits are clearly visible), divided by the total distance. The increase is therefore $= \frac{2D}{R}$ or in percentages, $\frac{200\,D}{R}$. The numbers given are thus twice the percentages of the changes in distance to produce the equivalent change in distinctness, and comparisons can therefore be made among the measurements without any assumption. The most suitable sources of *n*-rays were found to be wood or cork compressed, tempered steel, and unannealed glass, and estimates of the magnitude of the effect perceived were made. With the slits indistinct, on a source of *n*-rays being brought up behind the screen, the pattern came out more clearly, and the appearance of the screen was noted. On its return to the original condition, after removal of the *n*-rays, the screen was moved towards the observer until the decrease in distance produced a change similar to that produced by the strained substance. The two positions of the screen were marked and afterwards measured, and the increase of brightness deduced from the formula $\frac{200\,D}{R}$. The values obtained from different *n*-ray sources for the same screen are as follows :—

Source.	Increase of brightness.
Unannealed glass	10 per cent.
Compressed cork	9 „
Sounding Tuning-fork	8 „
Silent „	3 „

The effect of heat on the screen was observed, using a column of water 5 cm. long in a test-tube. When the water was at about 60° C., the increase of brightness was 5 per cent. ; with the water at 20° there was no change of brightness. It was found that a change of brightness of 3 per cent. could be clearly seen ; the heat effect of water at 20° must therefore be less than this. The effects due to strained substances can thus scarcely be ascribed to heat, as the increase of brightness caused by water even at 60° was much less than the effects due to strained substances. The minimum change which could be detected by an untrained observer was about 10 per cent., to be brought down to about 6 per cent. with a little practice. Using the screen without a diaphragm raised the minimum change visible, so that the effects just described would be invisible to a person with a 10 per cent. minimum, whilst they could only just be detected by one having a 6 per cent. minimum. This is considered to account for the numerous failures to observe the effects. An experiment is then described at length showing how it was concluded that the effect could only be due to *n*-rays. The only other effect of *n*-rays noticed by the author was that once an initial decrease of brightness was noticed under the influence of the *n*-rays in certain cases, soon succeeded by an increase in brightness; but this was not measurable. L. H. W.

REFERENCES.

2571. *Stereoscopic Range-finder.* **F. J. Cheshire.** (British Optical Journ. 3. pp. 35–37, Oct., 1903.)—A description of the principle of the instrument with mathematical consideration. J. W. P.

2572. *Geodetical Instruments.* **H. Grubb.** (British Optical Journ. 3. pp. 29–31, Oct., 1903.)—A new method by which the image of a near object may be thrown back into the plane of a distant object is described. The essential feature is a thin layer of amorphous lead sulphide deposited on glass. This gives reflected and transmitted rays with very little absorption. The device may be applied to the prismatic compass, clinometer, graphometer, hand-levels, gun-sights, &c. J. W. P.

2573. *Navigator's Prism.* **F. Teichgräber** and **K. Koss.** (Zeitschr. Instrumentenk. 24. pp. 218–219, July, 1904. Extract by **Hammer** from Mitt. a. d. Gebiete d. Seewesens, Heft 7. 1904.)—Some years ago Koss pointed out that the dip of the horizon ("Kimmtiefe") was considerably influenced by any difference in the temperature of the sea-water and of the air in contact with it; this may vitiate altitude determinations by many minutes of arc. He, therefore, devised a "Kimmprisma," consisting of two crossed prisms. The improved instrument of the authors is made by Rost, in Vienna, and forms a pentagonal prism; two faces meet at 90°, the next two faces cut these under 112° 30′, *i.e.*, they are at 45° to one another; the fifth face cut the sharp edge off under any angle. The prism is attached to the sextant, and the telescope pointed vertically downward so that the horizons on the right and left are seen; the prism can be turned about 90°. Reference is made to the navigator's prism of Blish, Proc. U.S. Naval Instit., 1903. H. B.

2574. *Lowell Spectrograph.* **V. M. Slipher.** (Astrophys. Journ. 20. pp. 1–20, July, 1904.)—A detailed description, with photographic reproductions, of the new spectrograph made by Brashear for the Lowell Observatory at Flagstaff, Arizona, in conjunction with the 61 cm. objective. The programme of work intended for the new instrument includes the determination of the rotation periods of the planets, and the study of planetary atmospheres by the comparison of their spectra with that of the sun. Preliminary tests on the rotation periods of Mars and Jupiter indicate that the performance of the new spectrograph is very satisfactory. C. P. B.

2575. *Improvements in the Spectrophotometer.* **H. Krüss.** (Zeitschr. Instrumentenk. 24. pp. 201–206, July, 1904.)—The author describes the improvements made in the spectrophotometer with Lummer-Brodhun prisms, by which errors, pointed out by H. Scholl, due to the optical construction, are now avoided. L. H. W.

2576. *Radiation Laws.* **E. Pringsheim.** (Zeitschr. Elektrochem. 9. pp. 716–718, Aug. 27, 1903. Report read before the Chem. Gesell. zu Breslau, July 3, 1903.) —A summary consideration of the laws of radiation, and the measurements which may be based on them. J. W. P.

2577. *The Axial Dioptric System.* **R. F. Muirhead.** (Phil. Mag. 6. pp. 326–343, Sept., 1903.)—A geometrical and analytical investigation.

2578. *Photography of Faint Celestial Spectra.* **H. K. Palmer.** (Astrophys. Journ. 18. pp. 218–235, Oct., 1903. Lick Observatory Bulletin, No. 35.)—The paper contains a detailed description of a small quartz spectrograph designed specially for the study of extremely faint celestial spectra. It was attached to the Crossley silver-on-glass reflector of 36-in. aperture. Results of the examination of several planetary nebulæ and Wolf Rayet stars are given, showing the work the instrument is capable of doing. It was found possible to obtain a well-exposed spectrum of Nova Cygni, whose magnitude is about 15·6, in four hours. C. P. B.

2579. *Comparison of Orthochromatic Plates.* **A. J. Newton** and **A. J. Bull.** (Photographic Journ. 43. pp. 262–270; Discussion, pp. 270–272, Oct., 1903.)—The results of tests on plates of various brands, made by exposure to a sensitometer and to the spectrum in such a way that the total photographic effect relatively corresponds. L. H. W.

2580. *Multi-coloured Solutions.* **J. Precht.** (Phys. Zeitschr. 4. pp. 572–573, Aug. 1, 1903. Physik. Inst. d. techn. Hochschule, Hanover, July 19, 1903.)—Several instances of two-coloured solutions are given in addition to those mentioned by Pflüger. [See Abstract No. 1954 (1904).] A remarkable multi-coloured solution can be made from a 0·225 to 0·25 per cent. aqueous solution of brilliant acid green 6B which, in increasing thickness, gives the colours green, blue-green, blue, dark blue, violet, purple, and red in the light from a glow-lamp. Data are given of the absorption spectrum of the solution. G. E. A.

2581. *Double Refraction in the Magnetic Field.* **A. W. Ewell.** (Phys. Rev. 17. pp. 292–301, Oct., 1903.)—The results of Majorana [see Abstract No. 1844 (1902)] are confirmed by subjecting colloidal solutions of iron to an alternating magnetic field. Negative double refraction disappears at 40°, and becomes positive at higher temperatures. The paper apparently follows the same lines as that of A. Schmauss. [See Abstract No. 1951 (1904).] G. E. A.

2582. *Radiant Efficiencies.* **E. L. Nichols** and **W. W. Coblentz.** (Phys. Rev. 17. pp. 267–276, Oct., 1903.)—The usual methods of measuring radiant efficiencies of sources of light are described, and the degree of inaccuracy in each is estimated. To the water-cell method a very large correction has to be applied. The ascertainment of this correction by the iodine-cell method is considered futile. J. W. P.

2583. *Optically Estimating Wood-fibre in Paper.* **N. Teclu.** (Zeitschr. Anal. Chem. 42. pp. 603–606, 1903.)—A method of estimating the percentage of wood-fibre in paper has been devised, based upon the property of the diminution of distinctness of a sharply focussed object under the microscope, as the distance of the objective from the object is altered. The fibres are stained red with phloroglucinol and hydrochloric acid, and the sample kept in motion on the stage by clockwork. The fine adjustment is furnished with an empirical scale, and the point at which motion of the image can no longer be detected is observed. L. H. W.

2584. *Stereoscopic Pictures.* **A. Schell.** (Akad. Wiss. Wien, Sitz. Ber. 112. 2a. pp. 1595–1625, Dec., 1903.)—The paper deals with the proper adjustment of the stereoscopic camera, the construction of the images, and the determination of the shape and size of the object from the size of the images. [See also Abstract No. 1945 (1904).] G. E. A.

2585. *Experiences with Red Sensitisers.* **J. Waterhouse.** (Photographic Journ. 44. pp. 165–171, June, 1904.)—The author recounts experiments made from 1875 onwards in improving the sensitiveness of plates for rays near the red end of the spectrum. Good photographs were obtained of the groups of lines from C to A, and in some cases to about λ8,400, by means of plates dyed with alizarin blue S. Another dye employed is orthochrom T, which not only makes the plate more sensitive to red, but also increases the general sensitiveness of the plate eight or nine times. Photographs of spectra and of coloured subjects are shown. G. E. A.

2586. *Refraction of Tourmaline.* **C. Soret.** (Archives des Sciences, 17. pp. 263–280, March, and pp. 573–588, June, 1904.)—Experimental data. Paper unfinished, through author's death; data compiled, conclusions not drawn. A. D.

2587. *Optical Properties of Developed Lippmann Emulsions.* **R. E. Liesegang.** (Ann. d. Physik, 14. 3. pp. 630–631, July, 1904.)—More pronounced colours are obtained by developing with hydroquinone than with pyrogallol, metol, or amidol as used by Kirchner [see Abstract No. 744 (1904)], and also with non-granular gelatinochloride than with the bromide of silver. An experiment is described which supports the theory that the various colours obtained are related to the size of the silver molecular complex. Some explanation is offered of a pseudo-solarisation observed by Kirchner. G. E. A.

2588. *Reflecting Power of Passive Iron.* **W. J. Müller** and **J. Koenigsberger.** (Phys. Zeitschr. 5. pp. 413–414, July 15, 1904.)—From measurements made on active and passive iron by means of a method previously described [see Abstract No. 1385 (1903)] it is concluded that the reflecting power of well-polished iron remains unaltered when the latter is rendered passive. It was impossible to distinguish, by optical means, the presence of a layer of oxide, which must therefore be less than λ/10 thick. G. E. A.

2589. *Optical Resonance.* **F. Ehrenhaft.** (Phys. Zeitschr. 5, pp. 387–390, July 1, 1904. II. physikal. Inst. d. k.k. Universität, Wien, 1904.)—In replying on points raised by Pockels [see Abstract No. 1394 (1904)] the author discusses the limiting values of wave-length and size of metallic particle necessary for the theory in the case of diffusion of light by colloidal solutions, and finds that the conclusions drawn from Thomson's theory of diffuse reflection and from optical resonance agree well with each other and with the observations made on Pt, Au, and Ag colloids.
G. E. A.

2590. *Effect of Temperature on the Rotatory Power of Strongly Optically Active Compounds.* **H. Grossmann** and **H. Potter.** (Ber. Deut. Chem. Gesell. 37. pp. 84–88, 1904.) — Although potassium and sodium molybdanyltartrates, $MoO_2(C_4H_5O_6K)_2$, behave normally, the specific rotatory power diminishing with the temperature, in the case of ammonium molybdanyldimalate, $MoO_2(C_4H_5O_5.NH_4)_2$, the specific rotatory power increases with the temperature to a maximum at 35°, after which it diminishes continually, but at a slower rate than the increase. For the complex salt in a 19·343 per cent. solution $[M]_D$ increases from $-122°$ at 10° to $-129·5°$ at 35°, and on increasing the temperature to 95° the value only recedes to 118·9. Sodium molybdanyldimalate also shows a maximum rotatory power at 50°. L. H. W.

2591. *Pigments of Geranium and Other Plants.* **A. B. Griffiths.** (Ber. Deut. Chem. Gesell. 36. pp. 3959–3961, 1903.)—The pigments of the petals of geranium, helianthus, and verbena have been isolated, and the absorption spectra of the pigments are described. The pigment of geranium in alcoholic solution has $[\alpha]_D - 74{\cdot}97°$, whilst the specific rotations of the pigments of verbena and helianthus are respectively $-85{\cdot}39°$ and $-59{\cdot}28°$. All three pigments in alcoholic solution apparently emit radiations which diminish the electrical resistance of selenium [see Abstract No. 614 (1904)]. L. H. W.

2592. *Light-sensitive Lead Salt Solutions.* **K. A. Hofmann** and **V. Wölfl.** (Ber. Deut. Chem. Gesell. 37. pp. 249–252, 1904.)—Under the influence of light, lead haloids in dilute sodium thiosulphate solutions deposit a red precipitate, whereas in the dark or in diffused light black lead sulphide is formed. In the case of lead chloride a polysulphide, $Pb_4S_6Cl_2$, is formed; with the iodide a copper-coloured powder, $Pb_3S_4I_2$, is produced. L. H. W.

2593. *Optical Investigation of Naphtha and its Distillation Products.* **M. A. Rakusin.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 36. pp. 554–559, 1904.)—The author's measurements show that both the colourless and the yellow distillates obtained from naphtha give rotations varying from +0·2 to +2·3 divisions of the Soleil-Ventzke scale in a tube 200 mm. long, the highest value being given by yellow cylinder oil from Baku naphtha. "Benzine" and petroleum from Grosny naphtha and also the yellow American cylinder oil "Viscolite" (of the Vacuum Oil Co.) exhibit dextro-rotations. T. H. P.

2594. *Spark Spectrum of Radium.* **C. Runge** and **J. Precht.** (Ann. d. Physik, 12. 2. pp. 407–412, Aug., 1903. Phys. Inst. Hannover, June, 1903.)—A table is given of the wave-lengths of 40 lines in the spark spectrum of radium bromide, taken by an induction coil on platinum poles, and photographed with a large concave Rowland grating. Comparisons with the values given by Demarçay and Exner and Haschek are indicated. [See Abstracts Nos. 664 (1899), 55 and 2417 (1900), and 1360 (1903).] C. P. B.

2595. *Spectrum of Potassium.* **W. Ritz.** (Ann. d. Physik, 12. 2. pp. 444–446, Aug., 1903.)—Experimental measurements of the wave-lengths of several lines in the potassium spectrum have been made in the endeavour to explain some ambiguities which are found when the spectrum is being resolved into series. The new values determined are given, and their association with the various series discussed. [See Abstract No. 533 (1904).] C. P. B.

2596. *Theory of Spectral Series.* **W. Ritz.** (Ann. d. Physik, 12. 2. pp. 264–310, Aug., 1903. Extract from Inaugural Dissertation.)—A much fuller account of the investigation dealt with in Abstract No. 72 (1904).

2597. *Spectrum of the Spontaneous Luminous Radiation of Radium at Ordinary Temperatures.* **W. Huggins** and **Lady Huggins.** (Roy. Soc., Proc. 72. pp. 196–199, Aug. 15, 1903.)—A photograph of this spectrum showed no lines due to radium, but eight other lines which were so close to the bands in the nitrogen spectrum as to justify the conclusion that they were due to this gas. [See Abstract No. 103 (1904).] E. C. C. B.

2598. *Motion of Particles in an Ideal Atom Illustrating the Line and Band Spectra and the Phenomena of Radio-activity.* **H. Nagaoka.** (Mathematical and Physical Soc., Tokyo, 2. 7. pp. 92–107, 1903.)—This is the complete paper giving the detailed equations referred to in an Abstract which was published separately. [See Abstract No. 961 (1904).] E. C. C. B.

2599. *Wave-length Measurements with the Concave-grating Objective Spectroscope.* **F. L. O. Wadsworth.** (Astrophys. Journ. 18. pp. 77–93, Sept., 1903.)—In previous papers the author has investigated the formulæ connected with the employment of the Rowland concave grating as an objective spectroscope, and recommended the method for use during eclipses. The performance of the instrument in actual use during the eclipse of 1900, however, convinced him of the existence of some inherent defects, and these are given at length in the present paper. The unsatisfactory results showed as a general lack of definition, which is ascribed to the use of a larger aperture for the grating than had been allowed for in the computation, and to the fact of the method of mounting the objective grating not being the best possible. A detailed analysis of the aberration with different apertures is given, in the present paper, and values are given of the actual wave-length displacements corresponding. [See also Abstracts Nos. 219, 220, 1366 (1903), and 1632 (1904).] C. P. B.

2600. *Arc Spectra in Different Atmospheres.* **A. S. King.** (Astrophys. Journ. 18. pp. 129–150, Sept., 1903. Extract of Dissertation.)—There is a definite selective action in the effects of surrounding atmospheres on spectral lines—an effect evidently connected with the series relations of the element. A change of vapour density in the arc seems to be the direct cause of the effects observed. The tendency of a low vapour density seems to be to make the arc spectrum more like that of the spark. [See also Abstract No. 1927 (1904).] A. D.

2601. *Chemical Spectroscopy.* **W. N. Hartley.** (Nature, 68. pp. 472–481, Sept. 17, 1903. Address delivered before Section B of the British Association at Southport.)—This is the report of the address delivered by the author as President of the Chemical Section of the British Association. Attention is chiefly directed to the similarities of the absorption spectra of various groups of chemically related series of substances, stereo-isomerism, spark spectra, and banded flame-spectra, with the bearing of recent work in connection with the harmonic formulæ found to apply to many of the elemental spectra. C. P. B.

2602. *Ultra-violet Spectrum of Radium.* **W. Crookes.** (Roy. Soc., Proc. 72. pp. 295–304, Oct. 19, 1903.)—The spark spectrum of a solution of radium nitrate was photographed with the iron spark spectrum in juxtaposition as standard. Self-induction was used in order to eliminate the air lines. Details of the 5 quartz-prism spectrograph and the methods of measurement and calculation are given in the paper. A reproduction of the radium spectrum is also appended. E. C. C. B.

2603. *Self-induction Spectrum of Silicium.* **A. de Gramont.** (Chem. News, 88. p. 238, Nov. 13, 1903. Abstract of paper read before the British Association at Southport (Section B), 1903.)—The lines of the spark spectrum of Si are divided into two classes according to their behaviour towards self-induction introduced into the circuit. (1) Such lines as are able to resist the introduction of a self-induction of 0·03 henry, or are even strengthened by its introduction; (2) such lines as become weaker with a self-induction of 0·0002 henry, and disappear simultaneously at 0·0062 henry. The spectra were obtained from sparks between Si crystals or molten sodium silicate, and were examined by the quartz spectrograph; they were measured relatively to the spectrum of a Cd-Pb alloy. Those lines present in star spectra are indicated. The results agree with those of Eberhard. [See Abstract No. 2537 (1904).] L. H. W.

2604. *Dark Bands in the Overlapping Spectra in Lippmann's Colour Photography.* **L. Pfaundler.** (Akad. Wiss. Wien, Sitz. Ber. 113. 2a. pp. 388–402, Feb., 1904.)—A consideration of these, which the author calls Zenker's bands. The system of light waves producing the spectra is examined, and the bearing of the phenomenon on colour photography is considered. J. W. P.

2605. *Spark Spectrum of Radium.* **C. Runge** and **J. Precht.** (Ann. d. Physik, 14. 2. pp. 418–422, June, 1904. Phys. Inst. d. Techn. Hochschule, Hannover, Feb., 1904.)—The authors give a number of new lines in the spark spectrum of radium, for which a more highly purified sample of radium bromide was employed than that used in their previous measurements [see Abstract No. 1367 (1903).] T. H. P.

2606. *Dynamical Illustration of Spectrum Lines.* **H. Nagaoka.** (Nature, 70. pp. 124–125, June 9, 1904.)—The letter is a reply in answer to criticisms [see Abstracts Nos. 961 and 962 (1904)] of a former paper by the author, which stated that his proposed dynamical system illustrative of spectrum lines would be unstable. He now further explains that the system is not electrically neutral, but is supposed to consist of a central charge very large compared with the negative charges in the outlying ring. Such a system will be generally stable. C. P. B.

2607. *Spectrum of the Nitrogen Flame.* **J. Schniederjost.** (Phys. Zeitschr. 5. p. 390, July 1, 1904. Physikalisches Institut, Halle, a.S.)—The experiments were undertaken to see if the third group of the nitrogen band spectrum is to be seen in the flame of nitrogen as obtained by a powerful coil discharge in air. A photograph was taken of the spectrum of this flame, and the third nitrogen group was plainly visible. E. C. C. B.

2608. *Radium and the Sun's Heat.* **J. Joly.** (Nature, 68. p. 572, Oct. 15, 1903. —Referring to Hardy's experiment in which no Becquerel rays from the sun can be detected, Joly calls attention to the fact that whatever the intensity of radio-activity might be at the surface of the sun, it can be shown by mere surface ratios, and, assuming no absorption, its activity per unit area at the distance of the earth must fall to about one forty-thousandth part. Moreover the earth's atmosphere is equivalent in mass to 76 cm. of mercury, no account being taken of the absorption in the solar atmosphere. The absence of β and γ radiations at the earth's surface is therefore not a weighty argument against the presence of radium in the sun. **R. J. Strutt.** (Nature, 68. p. 572, Oct. 15, 1903.)—A calculation is made by Strutt whereby it is shown that even if all the sun's heat were due to radium there is no possibility that the Becquerel radiation from it could ever be detected at the earth's surface. J. J. S.

2609. *Radio-active Materials.* **W. Marckwald.** (Elektrotechn. Zeitschr. 25. pp. 327–330, April 21, 1904. Report read before Elektrotechn. Verein, March 8, 1904.)—A *résumé.*

2610. *Radium and Selenium.* **A. Hess.** (Atti dell' Assoc. Elettr. Ital. 8. pp. 310–329, May–June, 1904.)—Of two lectures on the properties of radium and of selenium only the second portion of the first lecture is given, as the first part has been published in book form by the author with W. J. Hammer. A useful *résumé.* L. H. W.

2611. *Radium and the Electron Theory.* **J. Trowbridge** and **W. Rollins.** (Amer. Journ. Sci. 18. pp. 77–79, July, 1904.)—The radiation from radium bromide was caused to pass through an aluminium wire which was made to form one branch of a Carey-Foster bridge. No apparent effect upon the mechanism of the electric current was observed. J. J. S.

2612. *Action of Metals on Photographic Plates.* **J. Joly.** (Nature, 70. p. 395, Aug. 25, 1904.)—Mercury and polished speculum metal placed on a rapid plate under alcohol produce photographic effects. These are therefore due rather to ions than to the formation of hydrogen peroxide. G. E. A.

2613. *Kinetic Theory and Radio-activity.* **E. Bose.** (Phys. Zeitschr. 5. pp. 356–357, July 1, 1904.)—It is a consequence of the kinetic theory of gases that the internal energy of the atom is independent of the temperature. This is shown experimentally in the case of radio-active substances by the constancy of their activity at all temperatures. The activity of the radium emanation is the same for —180° as for +450°. J. J. S.

2614. *Volatile Product from Radium.* **Miss H. Brooks.*** (Nature, 70. p. 270, July 21, 1904.)—The emanation X of radium at one stage of the changes which it undergoes after being deposited on a solid body is slightly volatile even at ordinary temperatures. The volatile substance is not itself radio-active, it cannot pass without sensible loss through material substances such as paper and cotton-wool, and the activity excited by it is not concentrated on the negative electrode in an electric field, but distributes itself evenly over all surfaces exposed to it. A. D.

2615. *Radio-activity of Natural Gas.* **J. C. McLennan.** (Nature, 70. p. 151, June 16, 1904.)—The natural gas from different wells in Western Ontario has been found on examination to be charged with a radio-active emanation. J. J. S.

2616. *Source of Radio-active Energy.* **C. V. Burton.** (Nature, 70. p. 151, June 16, 1904.)—Comments on the supposition that annihilation of matter furnishes the energy of radio-activity. J. J. S.

2617. *Application of* N-*rays to Chemistry.* **A. Colson.** (Comptes Rendus, 138, pp. 1423–1425, June 6, 1904.)—The author states that *n*-rays were produced on adding zinc sulphate to baryta-water, but not in the converse experiment. [See also Abstract No. 1365 (1904).] T. M. L.

2618. *Action of* N-*rays on the Isolated Nerve Trunk.* **P. L. Mercanton** and **C. Radzikowski.** (Comptes Rendus, 138. pp. 1541–1542, June 13, 1904.)—The sciatic nerve of a frog is brought under the influence of *n*-rays derived from various sources. No effect on the activity of the nerve can be discovered by the "negative variation" test, nor is the electrical resistance of the nerve modified by the rays. In a decapitated frog the rapidity of reflex action was not changed by directing the rays on to the spinal cord. H. W. P. Y.

2619. N-*rays and Anæsthetics.* **J. Becquerel.** (Comptes Rendus, 138. pp. 1159–1161, May 9, 1904.)—The effects of anæsthetics in reducing the production of *n*-rays (by vegetables, E. Meyer) is general; sulphide of calcium and solarised sand have their *n*-radiations suspended by chloroform, ether, or nitrous oxide, after preliminary periods of excitement. A. D.

2620. N-*rays and the Brain.* **A. Broca.** (Comptes Rendus, 138. pp. 1161–1163, May 9, 1904.)—Practical details as to methods of observation: the construction of screens, of very thin layers of sulphide of calcium protected by collodion and made phosphorescent by diffused daylight. The cranial sutures give off no *n*-rays, or little. The variations of brightness in the screens must be observed by lateral vision, not axial. A. D.

2621. *Blondlot's* N-*rays.* **E. Salvioni.** (Accad. Lincei, Atti, 13. pp. 610–616, June 4, and pp. 703–706, June 19, 1904.)—The author has had poor success in reproducing Blondlot's phenomena, but he has had some results which seem scarcely attributable to chance. After studying the *subjective* sources of error he concludes that the phenomena require a particular condition of sensibility, differing not only from person to person, but in the same person from one time to another; and he compares them to the alleged luminous phenomena of the so-called animal magnetism, which science has repudiated. A. D.

HEAT.

2622. *Critical Heat.* **A. Schükarew.** (Zeitschr. Phys. Chem. 44. pp. 548–562, Aug. 4, 1903, Univ. Therm. Laborat. Moskau.)—This, the heat required to raise 1 gm.-molecule to the critical from the ordinary temperature, is measured by the method of Louguinine [see Abstract No. 817 (1901)]. The liquid is contained in a sparklet provided with a fine platinum tube at the top, and has a volume of about 6 c.cm. Values are given for isopropyl and methyl alcohols, acetone and ether and constants calculated on the basis of van der Waals' equation. Similar determinations of the so-called "two-phase heat" below the critical temperature (with alcohol) are given. H. H. F. H.

2623. *Practical Attainment of the Thermodynamic Scale of Temperatare. II.* **J. Rose-Innes.** (Phil. Mag. 6. pp. 353–358, Sept., 1903.)—The finding of any temperature on the thermodynamic scale [compare Abstract No. 2126 (1901)] resolves itself into two minor problems: (1) To find the absolute value of the freezing-point of water, and (2) to find the value of the interval between the freezing-point of water and the temperature under discussion. Former determinations of the freezing-point of water show considerable deviations between the nitrogen (273·361°) and hydrogen (273·153°) thermometers. A great part of this difference may be conditioned by wrong values for the Joule-Thomson effect, and fresh calculation leads to the numbers, 273·13° (nitrogen) and 273·03° (hydrogen). The still remaining difference is to be ascribed to the influence of the walls of the containing vessels, and it is difficult to avoid, as it is not known to what extent it acts in either case. T. H. P.

2624. *Stefan's Law.* **E. Buckingham.** (Phys. Rev. 17. pp. 277–280, Oct., 1903.)—Consider a cylindrical enclosure of volume v formed of black surfaces and provided with a frictionless black piston, the whole being at absolute temperature θ; then, if ϕ is the radiation-energy per unit volume and the radiation is the same in all directions, the radiation-pressure p is $\frac{1}{3}\phi$. Isothermal increase of the volume by dv entails external work $\frac{1}{3}\phi dv$ and increase of radiation-energy ϕdv, or an increase of entropy by $\frac{4}{3}(\phi/\theta)dv$, whence, by Maxwell's third thermodynamic relation—

$$\frac{4}{3}\phi/\theta = (\partial p/\partial\theta)_v = \frac{1}{3}(\partial\phi/\partial\theta)_v,$$

and thus $\phi = \theta^4 f(v)$. The author prefers to look upon $\frac{1}{3}\phi dv$ above as the decrease of the free energy ψ and on ϕdv as the increase of the intrinsic energy ϵ, and to employ the free energy equation $\psi = \epsilon + \theta(\partial\psi/\partial\theta)_v$. [Many important assumptions are here tacitly made—too many to be particularised.] R. E. B.

2625. *Modification of the Plug Experiment.* **E. Buckingham.** (Phil. Mag. 6. pp. 518–521, Oct., 1903.)—A repetition and extension of the original plug-experiment are advocated with heat supplied electrically so as to prevent fall of temperature during the expansion. If λdp is the heat *absorbed* per unit mass at absolute temperature θ during isothermal *fall* of pressure dp, then, with a usual notation, $d(\epsilon + pv) = \lambda dp$, and consequently, as the actual changes of energy and entropy *of the whole mass of gas* may be taken as if the flow were a reversible process—

$$v - \lambda = -\theta(\partial\eta/\partial p)_\theta = \theta(\partial v/\partial\theta)_p,$$

by Maxwell's first thermodynamic relation. Thus—

$$\log(\theta_2/\theta_1) = \int_{v_1}^{v_2} dv_p/(v-\lambda)_p,$$

so that absolute temperatures may be determined in terms of those given by a constant-pressure thermometer filled with the gas under consideration. [For, if on such thermometer at constant pressure P temperatures are given by $t = \mathrm{Q}v$, and if L denotes the value of λ at t for the pressure P, then $\log \theta_2/\theta_1 = \int_{t_1}^{t_2} dt/(t - \mathrm{QL})$.] R. E. B.

2626. *Boiling of Sulphur, Selenium, and Tellurium in Exhausted Glass Tubes in the Electric Furnace.* **F. Krafft** and **L. Merz.** (Ber. Deut. Chem. Gesell. 36. pp. 4344–4350, 1903.)—In a former paper the authors have shown [see Abstract No. 1500 (1903)] that selenium and tellurium boil at remarkably low temperatures. Further observations have now been made, electrically heated glass vessels being employed, and the temperatures being determined by a thermo-couple. Pure tellurium boils very constantly at 478° under a 58 mm. column of vapour, pure selenium boils at 310°, 60 mm., the temperature rising slightly when rapidly superheated. Sulphur boils under similar conditions at about 140°, and the series of boiling-points thus shows a constant difference; Te — Se = 168°, Se — S = 170°. The temperatures may readily be determined in glass flasks without an electric furnace, thermometers of borosilicate glass being used. The behaviour of sulphur was studied in greater detail, the sulphur being in some cases heated until it assumed the viscous state, the temperature of both liquid and vapour being measured.

Height of Column of Vapour.	Temp. of Vapour of normally Boiling Sulphur.		Temp. of Vapour of Colloidal Sulphur.		Temp. of Colloidal Sulphur.	
40 mm.	136–138°	Diff. 15–14°	183–187°	Diff. 16–15°	204–208°	Diff. 19–17°
115 mm.	151–152		199–202		223–225	

The existence of the colloidal variety of sulphur is thus dependent on the pressure, the superheated vapour above the colloidal sulphur being influenced by the pressure of the column of vapour to the same extent as that from normal sulphur. L. H. W.

2627. *Internal Work Accompanying the Isothermal Expansion of Steam.* **O. Tumlirz.** (Akad. Wiss. Wien, Sitz. Ber. 113. 2a. pp. 380–387, Feb., 1904.)—Using the results of his previous papers [see Abstracts Nos. 624 (1898), 2009 and 2010 (1900)] and taking the intrinsic energy of dry saturated steam to be the excess of Regnault's "total heat of steam" over the external work during isothermal vaporisation, the author calculates the internal work accompanying the isothermal change of steam from the saturated state to that in which the intrinsic energy depends only on the temperature. These amounts vary from − 10·01 calories per gm. at − 20° C. to + 20·51 calories per gm. at 200° C., there being no internal work at 49·46° C. These results seem to show that above 49·46° C. saturated steam must partly consist of complex molecules, and that below 49·46° C. there must be partial dissociation; these conclusions have been previously deduced by the author from other considerations, but with 31·85° in lieu of 49·46° C. [See Phys. Soc. Abstract No. 397 (1897).] R. E. B.

2628. *Heat of Formation of Glucinum Chloride.* **J. H. Pollok.** (Chem. Soc., Journ. 85. and 86. pp. 603–611, April, 1904.)—Metallic glucinum, obtained from the chloride by heating with sodium and washing, first with absolute alcohol, then with hot water, was treated with moderately strong hydrochloric acid in a thin glass globe immersed in a calorimeter, the escaping gases being cooled by passage through a spiral. The evolved hydrogen was collected and measured, from which the amount of glucinum dissolved was calculated. By measuring the rise in temperature of the water, the amount of heat generated was known, and after adding the heat of formation of hydrochloric acid in solution the molecular heat of formation of glucinum chloride in solution was found to average 199,500 cal., of which 44,500 cal. are due to the solution of the salt in water, leaving 155,000 cal. as the molecular heat of formation of glucinum chloride. This is much higher than that of an equivalent quantity of aluminium chloride, but the heat of solution of the latter is somewhat the greater. Compared with magnesium and zinc, a rise in the atomic weight is accompanied by a fall in the heats of formation and solution. W. H. Si.

2629. *Action of Silica on the Melting of Alkali Carbonates.* **N. M. v. Wittorf.** (Zeitschr. Anorg. Chem. 39. 2. pp. 187–196, April 2, 1904. Laborat. für anorgan. Chemie, Göttingen.)—Results are given of experiments on the equilibrium between carbon dioxide and silica competing for the same alkaline oxide. The alkali carbonate and silica are heated in a covered crucible until of constant weight, the partial pressure of the carbon dioxide being 0·07 atmosphere. If the latter is altered by passing in more or less carbon dioxide, the equilibrium undergoes a change which is complete after about 20 minutes. When the molten mass crystallises no evolution of gas is observed. When equilibrium is established in a mixture of 3·035 gm. of Na_2CO_3 and 0·863 gm. of silica, the partial pressure of the carbon dioxide being 0·07 atmosphere and the temperature 1,300°, about 20 per cent. of the original sodium carbonate remains undecomposed, and at 870° about 34·5 per cent. With a mixture of 2·890 gm. of potassium carbonate and 1·262 gm. of silica, 10 per cent. of the carbonate is not decomposed at 1,300° and 19 per cent. at 870°, after equilibrium has been established under a partial pressure of 0·07 atmosphere. The statement that silica expels carbon dioxide is true only in those cases where the partial pressure of the carbon dioxide rises. The increased amount of carbon dioxide obtained as the partial pressure rises becomes larger as the atomic weight of the alkali metal increases, and is so considerable that it cannot be accounted for by the dissociation of the carbonate. A diagram having as ordinates the partial pressures, and as abscissæ the value of the relationship, oxide : oxide + carbonate (in gm.-mols.), shows that the molecular quantities of the oxides of different alkali metals increase with increased dissociation pressure of the melted mass, if the same partial pressure of carbon dioxide is kept over it. The amount of alkali oxide formed in the molten mass of the carbonate, under the same conditions for different carbonates, decreases in the series : Li_2CO_3, Na_2CO_3, K_2CO_3, Rb_2CO_3, and Cs_2CO_3.

T. H. P.

2630. *Condensation of Gases at the Walls of Retaining Vessels.* **G. Melander.** (Boltzmann Festschrift, pp. 789–792, 1904.)—In earlier researches the author found that the coefficient of expansion of gases does not decrease in a constant manner with decreasing pressure, but reaches a minimum. This was held by Wüllner to be possibly due to a gradual liberation of the condensed gases from the walls of the vessel. The author has investigated this question, using two similar glass globes joined together by a capillary tube connected to a compression apparatus, the inside of one being plain whilst that of the other had a ground surface (etched with sodium fluoride). One globe was kept at 0° and the other at 100°, and the level of the mercury in the compression apparatus determined. On reversing the temperatures of the two globes the mercury should give unaltered readings if the condensed gas was uninfluential. It was found that with the etched globe at 100° a slow creeping up of the pressure took place, so that condensation does influence the results. The research is to be continued. L. H. W.

2631. *Influence of Pressure on the Melting-points of Tin and Bismuth.* **G. Tammann.** (Zeitschr. Anorg. Chem. 40. 1. pp. 54–60, June 28, 1904. Institut für anorg. Chemie, Göttingen.)—The author studies the influence of pressure on the melting-points of tin and bismuth by fusing the metal in an electric furnace and determining the curves of cooling at different pressures by means of a thermo-couple. Increase of pressure raises the melting-point of tin but depresses that of bismuth. If p represents the pressure in kg. per sq. cm., the change of the melting-point with pressure is given by $\Delta t = -0{\cdot}00386(p-1)$ for bismuth, and $\Delta t = +0{\cdot}00216(p-1)$ in the case of tin. T. H. P.

2632. *Allotropic Forms of Antimony Sulphide. Heats of Formation.* **Guinchant** and **Chrétien.** (Comptes Rendus, 139. pp. 51–54, July 4, 1904.)—On heating antimony sulphide in a stream of nitrogen at about 850° and rapidly condensing the vapours a sublimate is obtained consisting of a mixture of lilac, transparent globules, and black needles. The specific gravities of the various forms at 0°/0° are : precipitated red sulphide, 4·120 ; sublimed lilac form, 4·278 ; fused precipitated black sulphide, 4·652 ; synthesised black sulphide, 4·659. Taking Berthelot's value, 34 cals., for the heat of formation of the moist precipitated sulphide, the heats of formation (from octahedral sulphur) of the other forms are found to be as follows : the dried precipitate, 32·6 ; lilac sublimate, 33·9 ; and the black form, 38·2 cals. **Berthelot.** (Comptes Rendus, 139. pp. 97–98, July 11, 1904.)—Berthelot calls attention to inaccuracies in the references to his work on this subject, by Guinchant and Chrétien. T. H. P.

2633. *Limits of Miscibility of Boric Anhydride and Borates in Fused State.* **W. Guertler.** (Zeitschr. Anorg. Chem. 40. 2. pp. 225–253, July 8, 1904. Institut für anorg. Chemie der Univ. Göttingen.)—The author divides the different metallic oxides studied into three classes : (1) All mixtures of the oxides with boric anhydride from the composition of the orthoborate to pure boric anhydride yield clear homogeneous melts. On cooling these they either crystallise or yield clear glasses. No separation into layers takes place. To this class belong the oxides of lithium, potassium, sodium, rubidium, cæsium, thallium, and silver. (2) All mixtures of the oxides with boric anhydride from the composition of the orthoborate to pure boric anhydride also give at high temperatures clear homogeneous melts. On cooling, however, mixtures of a composition lying within a certain range, separate into two liquid phases and form an emulsion, corresponding to the partial miscibility of phenol and water. The "solubility curve" for PbO and B_2O_3 has been determined. The oxides belonging to this class are those of copper, lead, bismuth, antimony, arsenic, titanium, molybdenum, tungsten, and vanadium. (3) The third class of oxides yield crystalline orthoborates, as well as one or several other borates. The mixtures containing higher amounts of boric anhydride do not, however, even at a temperature of 1,400°, yield clear homogeneous melts, but separate into two layers. The oxides belonging to this group are those of calcium, strontium, barium, magnesium, zinc, cadmium, manganese, iron, cobalt, nickel, cerium, lanthanum, neodymium, praseodymium, samarium, gadolinium. The composition of the lower layer corresponds in most cases to that of the metaborate. Nickel, the alkaline earth metals, and manganese are exceptions. A. F.

2634. *Determination of Melting-points.* **L. Maquenne.** (Bull. Soc. Chim. 31. 8. pp. 471–474, 1904. Chem. News, 90. pp. 27–28, July 15, 1904.)—With readily decomposable compounds the melting-point is lower, the more slowly the substance is heated up to it. In order to make the heating rapid and to render unnecessary any correction of the temperature obtained, the author devised some seventeen years ago a metal block, with the help of which a substance can be melted in less than one second. The temperature of the block is gradually increased, and from time to time a small quantity (about 0·1 gm.) of the substance is thrown on to the surface of the metal, where it is allowed to remain only a moment; this procedure is continued until a point is reached where the substance melts the instant it touches the metal. The block is then allowed to cool, and the melting-point similarly determined. The mean of these two temperatures, which should not differ by more than a fraction of a degree, is taken as the melting-point of the substance. The great advantage of stating the instantaneous melting-point of a compound is that it is unnecessary to give the conditions under which the heating has been carried out. T. H. P.

2635. *Melting-points of Mixtures of the Alkaline Earths with Boric Anhydride.* **W. Guertler.** (Zeitschr. Anorg. Chem. 40. 3. pp. 337–354, July 30, 1904. Institut. für anorg. Chemie der Univ. Göttingen.)—The author has studied the cooling curves of various mixtures of alkaline earth oxides and boric anhydride, and has constructed from these the freezing-point curves of the mixtures. The existence of the following borates has been proved :—

	Mg.	Ca.	Sr.	Ba.
Orthoborate	$3MgO\,.\,B_2O_3$	$(3CaO\,.\,B_2O_3)$?	$(3SrO\,.\,B_2O_3)$?	$3BaO\,.\,B_2O_3$
Pyroborate	$2MgO\,.\,B_2O_3$	$2CaO\,.\,B_2O_3$	$2SrO\,.\,B_2O_3$	$2BaO\,.\,B_2O_3$
Metaborate	—	$CaO\,.\,B_2O_3$	$SrO\,.\,B_2O_3$	$BaO\,.\,B_2O_3$
Biborate	—	$CaO\,.\,2B_2O_3$	$SrO\,.\,2B_2O_3$	$BaO\,.\,2B_2O_3$

A. F.

2636. *Thermodynamics of Water Gas.* **O. Hahn.** (Zeitschr. Phys. Chem. 44. pp. 513–547, Aug. 4, 1903. Physikal. chem. Institut, Leipzig.)—The author discusses the importance of the question and former investigations. He produces mixtures of H_2 and CO_2, or of CO and water vapour, in specially constructed thermostats. The mixtures are passed through a tube heated to a high temperature (1,005° C.), containing platinum as catalyser. Tubes of glass, porcelain, and silica were tried. They are heated electrically by means of a platinum-iridium spiral, the voltage being controlled by a regulator. Temperature is measured by a le Chatelier thermo-element. The results show that the mass law holds to 1,400°, where slight dissociation occurs, and that to 1,100° the constant $K = CO \,.\, H_2O/CO \,.\, H_2$ is given by—

$$\log K = -2232/T - 0{\cdot}08463 \,.\, \log T - 0{\cdot}0002203T + 2{\cdot}5084.$$

[See also Abstract No. 199 (1904).] H. H. F. H.

2637. *Van der Waals' Equation and the Physical Properties of Metals.* **J. Traube.** (Zeitschr. Vereines Deutsch. Ing. 47. pp. 1186–1189, Aug. 15, 1903.)—This equation having previously been applied to highly-compressed gases, and later to liquids, the present paper is an attempt to extend it to the solid state. Metals are chosen for the first attempt in this direction on account of the simple and probably mon-atomic character of their molecules, even in the solid state. In the equation $(p + a/v^2)(v - b) = RT$, the author has calculated the values of the coefficients a and b for temperatures near 0° C., by substituting for v the values of the volumes for two temperatures near 0° C., using Fizeau's values for expansion coefficients. By means of a table of figures it is pointed out that the values of the co-volumes $(v - B)$ are small compared to the values of this function in the case of compounds, and are approximately inversely proportional to the volume (v), while the internal pressures, $a/v^2 = K$ are mostly very considerable, ranging from 8,080 atmospheres in the case of potassium to 486,600 for osmium, and 5,458,800 for diamond. On the assumption of T. W. Richards, heat supplied to a metal $(= C.\ dt$, where C is the specific heat and dt the rise of temperature) is entirely expended in overcoming the internal pressure, *i.e.*, $C \,.\, dt = K \,.\, dv$. The author's table, however, shows that Richards' values are just three times as great as they should be on this assumption, and he concludes that only 1/3 of the energy is expended in overcoming the internal pressure, the remainder serving to augment the kinetic energy of the molecules. Simple calculation then shows that the coefficient of expansion of the co-volume of a metal is a constant and equal to 1/273, and that consequently the internal pressures vary very little with temperature. It thus becomes possible to calculate the coefficients of expansion of metals from van der Waals' equation, or conversely to find the values of the constants a and b from the measured coefficients of expansion. It further follows that the thermal expansion of metals is almost entirely confined to the intra-molecular space, while compression and chemical action also affect the proper volumes of the molecules (b). It is next suggested that hardness and elasticity should be proportional to the internal pressure. In a table of hardness, elastic moduli, and values of a/v^2 it is shown that there is a strict parallelism between the moduli of elasticity and the internal pressures; the coefficients of hardness show a few departures from strict parallelism, but these are ascribed to the influence upon hardness of minute quantities of impurities. The cause of this marked influence has not hitherto been fully explained. Taking the case of carbon and iron, the author quotes the fact that in the unhardened state iron can maintain in solution only 0·29 per cent. of carbon, any excess being deposited as graphite. On the assumption that only so much carbon is soluble in iron as can find room in the intra-molecular spaces (the co-volume), during slow cooling any excess of carbon would be pressed out and deposited as graphite as the co-volume diminished. On this basis the solubility of carbon in iron is calculated to be 0·287 per cent., but the author points out that this close agreement may be a coincidence, as he has no data for further examples. In a further table the parallelism between co-volume and compressibility is illustrated, and the author also considers the relation between melting-point, boiling-point, latent heat of vaporisation, coefficients of expansion of metals, and van der Waals' constants. With reference to the known parallelism between coefficients of expansion and melting-points in absolute temperature, a table is given of expansion coefficients, melting- and boiling-points, and certain functions of the internal latent heat of vaporisation, the principal result being that $3\alpha(\lambda - RT) = \text{constant}$, where α is the coefficient of expansion, λ the total latent heat of vaporisation, and $\lambda - RT = a/v$ is the internal latent heat of vaporisation. The constancy is only approximate, the value of the constant varying for a series of metals from 1·7 to 2·3. Finally the author connects Trouton's rule of the inverse proportionality of boiling-point and latent heat of vaporisation with van der Waals' equation, and arrives at the conclusion that the application of van der Waals' equation to metals furnishes a useful guide to their physical behaviour. W. R.

2638. *Isotherms of the Dissociation of Sulphur at 448°.* **G. Preuner.** (Zeitschr. Phys. Chem. 44. pp. 733–753, Aug. 18, 1903.)—The experimental curve shows that the dissociation can only be explained by supposing the simultaneous existence of the molecules S_2, S_4, S_6, and S_8. The author gives three equations between these, to which any others can be reduced, as well as curves showing the partial pressures of each at various total pressures between 10·4 and 453·4 mm. H. H. F. H.

2639. *Relations between the Thermic Properties of Substances.* **A. Batschinski.** (Ann. d. Physik, 14. 2. pp. 288–308, June, 1904.)—It can easily be deduced from van der Waals' equation of state and Cailletet and Mathias' law (linear diameter), that pvV should be a linear temperature-function, where p = pressure, v = specific volume of liquid, V = specific volume of vapour. From the results of Ramsay and Young, it is found that the curve $z = f(T)$, where $z \equiv pvV$, is a parabola, and the temperature-function can be written in the form :—

$$z = \alpha T - \beta + \gamma\sqrt{T_c - T}.$$

In this equation T_c = critical temperature, and α, β, and γ are coefficients. The author calculates the coefficients for ethyl ether, fluorobenzene, methyl formate and isopentane, and recommends the above equation for extrapolating the values of V at lower temperatures. Differentiation with respect to T of the van der Waals' equation $p(V - v) = RT \log\frac{V - b}{v - b} + \frac{a}{V} - \frac{a}{v}$, leads to the result that the function $y \equiv \left(T\frac{dp}{dT} - p\right)vV$ should be equal to the van der Waals' constant a. From the measurements of Ramsay and Young, and Young and pupils, tables of y are calculated for the previously mentioned substances. It is found that y decreases with increasing temperature. This relationship is found not to agree with the law of corresponding states. In the last portion of his paper the author arrives at the conclusion that the inner heat of evaporation is approximately proportional to the difference of the squares of the densities of liquid and vapour. [Has this result not been obtained previously by Bakker ?] **F. G. D.**

2640. *Freezing-point Curves of Dynamic Isomerides: Ammonium Thiocyanate and Thiocarbamide.* **A. Findlay.** (Chem. Soc., Journ. 85. and 86. pp. 403–412, March, 1904.)—The freezing-point curve of ammonium thiocyanate (M. Pt. 149°) and thiocarbamide (M. Pt. above 177°) is of the simplest type, consisting of two branches meeting at a eutectic point (104·3°). The "natural" freezing-point is 114–115°, the stable solid form being ammonium thiocyanate. There is no indication of the existence of a compound $(NH_4CNS)_3 . CS(NH_2)_2$. This disposes of the extraordinary conclusions arrived at by Reynolds and Werner. [See Abstract No. 1264 (1903).]
F. G. D.

2641. *Theory of Saturation Phenomena of Binary Mixtures.* **P. Boedke.** (Zeitschr. Phys. Chem. 48. pp. 330–344, June 7, 1904. Extract from the Berliner Dissertation.)—The author's object is, starting out from the general conditions of equilibrium in a two-component biphasic liquid system and the empirical data of experiment, to deduce expressions for the isotherms, which will thus apply to concentrated solutions and to the critical region. Denoting by ϕ the specific value of Planck's function Φ and setting $\partial\phi/\partial c_1 = \lambda$, for equilibrium between the two phases $\lambda' = \lambda''$; in the case of dilute solutions we have $\lambda = \psi - r_1 \log c_1 + r_2 \log c_2$, where r_1 and r_2 are constants, ψ a function of temperature and pressure only, and c_1 and c_2 the concentrations of the two components. In order now to proceed to concentrated solutions, the author makes use of Rothmund's experimental result, $c_1' + c_1'' = A + BT$ (the dashes indicate the phases). This result will follow if we put $\lambda = F(a + bc_1 + dc_1^2)$ where a, b, and d are independent of c_1. Regarding this expression for λ merely as a series development, in which only the chief terms have been taken account of, the author makes the explicit assumption that this series remains convergent for solutions dilute with respect to one component, and writes therefore :—

$$\lim_{c_1=0} F = \psi - r_1 \log c_1$$

as a boundary condition. From this it follows that F contains the term $\psi - r_1 \log \left\{c_1\left(1 + c_1\frac{d}{b}\right)\right\}$, and, from considerations of symmetry, the term $\psi - r_1 \log \left\{c_1\left(1 + c_1\frac{d}{b}\right)\right\} + r_2 \log \left\{c_2\left(1 + \frac{d'}{b'}c_2\right)\right\}$. If we make the assumption that this expression already contains the chief terms of the series development for λ, we can write finally :—

$$\lambda = \psi - r_1 \log \left\{c_1\left(1 - \frac{c_1}{1-a}\right)\right\} + r_2 \log \left\{c_2\left(1 - \frac{c_2}{1+a}\right)\right\}$$

observing that, since $c_1 + c_1'' = -b/d$, and $c_2' + c_2'' = -b'/d'$, $b/d + b'/d' = -2$, and therefore we may put $b/d = -(1-a)$, $b'/d' = -(1+a)$. One of the author's deductions from this result is found to be in several cases in very good agreement with experiment. **F. G. D.**

2642. *Significance of the Coefficient* B *in the Expression for the Change of Free Energy.* **H. v. Jüptner.** (Zeitschr. Anorg. Chem. 40. 1. pp. 65–67, June 23, 1904. K.K. technische Hochschule, Wien.)—In the expression for the change of free energy occurring in any reaction, namely—

$$A_T = A_0 + BT - 2{\cdot}30259\,(\alpha_2 - \alpha_1)T.\log T - (\beta_2 - \beta_1)T^2 - (\gamma_2 - \gamma_1)T^3/2,$$

the coefficient $B = R \times$ a constant, *i.e.*, the product of the gas constant $R(= 1{\cdot}982$ cal.) and a constant obtained from van't Hoff's equation, $dlK = -Q_T dT/RT^2$, by integration, which gives : $\int Q_T dT/RT^2 + lK =$ constant. The calculation of this constant is given for several reactions. [See also Abstract No. 2231 (1904).] T. H. P.

2643. *Fundamental Law of Osmotic Phenomena.* **E. Ariès.** (Comptes Rendus, 139. pp. 196–198, July 18, 1904.)—The author gives a thermodynamic proof for the following fundamental law on which the theory of osmosis is based : When a solution at a certain temperature and under the pressure p_1 is in osmotic equilibrium with the pure solvent at the same temperature and a pressure p_2, the potential of the pure solvent is equal to that of the solvent in the solution. In its most general form, this law becomes : An equilibrated system being divided into n partial systems at the same temperature by porous partitions permitting or preventing the free passage of certain bodies between contiguous partial systems which remain under the pressures $p_1, p_2, \ldots, p_n$, the molecular and individual potential of any one body is constant, whatever be the space it occupies in the entire system. T. H. P.

REFERENCES.

2644. *Telescope-Pyrometer.* **C. Féry.** (Soc. Franç. Phys., Séances, 1. pp. 32–35, 1904.)—The author has modified a previous form of pyrometer [see Abstracts Nos. 1003 and 1176 (1903)] to measure temperatures below 800°. A concave mirror silvered on the back is put in place of the objective in the ordinary telescope-pyrometer, and reflects the rays on to the thermo-couple. The readings of the instrument are thus extended down to 500°, and the instrument can be used for industrial purposes. G. E. A.

2645. *Heat of Combustion of Molybdenum.* **M. Delépine.** (Bull. Soc. Chim. 29. 3. pp. 1166–1167, 1903.)—In the combustion calorimeter the values obtained for anhydrous molybdic acid were—

$$\begin{aligned}\text{Mo (solid)} + O_3\ \text{(gaseous)} = MoO_3\ \text{(solid)} &+ 166{\cdot}14\ \text{cal. (V = const.)}\\ &+ 167{\cdot}0\ \ \text{,, (P = const.)}\end{aligned}$$

L. H. W.

2646. *Ratio of the Specific Heats of Nitrogen at Temperature of Liquid Air.* **S. Valentiner.** (Kais. Akad. München. Sitzber. pp. 691–741, 1903. Ann. d. Physik, 15. 1. pp. 74–106, Sept. 27, 1904.)—The author has investigated the ratio of the specific heats of nitrogen by means of dust figures in two Kundt's tubes, one of which was kept at a constant temperature, and the other cooled with liquid air. Temperature was measured electrically, and the pressure range was 16 to 121 cm. of mercury. As a result it is found that the ratio increases with the pressure to the amount of 5 per cent. over this range ; and it is considered that the ratio Cp/Cv at the temperature of liquid air, and at sufficiently low pressures, is most probably the same as at ordinary temperatures. L. H. W.

SOUND.

2647. *Lip-pipes and the Vibrations of Sheets of Gases.* **R. Wachsmuth.** (Ann. d. Physik, 14. 3. pp. 469–505, July, 1904.)—The phenomena which occur when a sheet of air, emitted from a slit, strikes a wedge, are investigated. The air is driven under constant pressure through a slit 0·1 cm. broad and strikes a wedge whose edge is parallel to the slit. The distance is variable and the effect on pitch is observed. The action of the resonance tube is considered. Curves of frequency against distance between slit and wedge and of frequency against pressure are shown. The second part deals with the objective exposition of the frequencies by photographic means. J. W. P.

REFERENCES.

2648. *Architectural Acoustics.* **G. W. Stewart.** (Phys. Rev. 16. pp. 379–380, June, 1903. Abstract of paper read before the American Physical Society, April 25, 1903.)—A verification by measurements in the auditorium of Sibley College, Cornell University, of Sabine's empirical formula for the time of reverberation. J. W. P.

2649. *Tones of Air Sheets.* **M. Weerth.** (Ann. d. Physik, 11. 5. pp. 1086–1099, July 7, 1903. Extract of the Rostocker Inaugural Dissertation.)—The tones produced when sheets of air at various pressures are made to strike on the edge of a wedge, are investigated. Arithmetical values for pressure and frequency are given. The effect of the distance of the wedge from the source is examined. J. W. P.

2650. *Acoustic Field.* **P. Charbonnier.** (Comptes Rendus, 137. pp. 378–380, Aug. 10, 1903.)—A further consideration [see Abstract No. 1724 (1904)] especially in relation to the so-called internal friction of a gas. J. W. P.

2651. *Acoustic Field.* **Sebert.** (Comptes Rendus, 137. pp. 357–362, Aug. 10, 1903.)—An account of previous investigations on the aerodynamics in relation to rapidly moving bodies and a special review of Charbonnier's work. [See Abstracts Nos. 1724 and 1896 (1904).] J. W. P.

2652. *Theory of Resonance.* **G. Jäger.** (Akad. Wiss. Wien, Sitz. Ber. 113. 2a. pp. 314–325, Feb., 1904.)—A mathematical consideration of some points in the investigations of Exner and Pollak upon the sound effect produced by a sudden reversal of direction of motion. J. W. P.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS, AND ATMOSPHERIC ELECTRICITY.

2653. *Electromagnetic Field Generated by the Uniform Translation of an Electric Charge in Direction Parallel to a Conducting Plane.* **T. Levi-Civita.** (N. Cimento, 6. pp. 141–185, Sept., 1903.)—This treatise is almost a translation of one published by the writer in the Annales de la Faculté des Sciences de Toulouse, Jan., 1902. It begins with a short history of the subject, from which it appears that in 1900 Crémieu was led by his experiments to doubt the results obtained originally by Rowland, and, following him, by Himstedt, Röntgen, and Hutchinson, namely, that electric convection has a magnetic effect corresponding to that of the ordinary electric current. Righi, however, entered the field with new experiments, and in response to his invitation the writer here gives in an Italian form his analytical solution of the problem already explained in the Toulouse Annales. Levi-Civita's theory of the retarded potential is too well known to require an Abstract, nor would it be possible in an Abstract to do it justice. In one respect the present Italian work differs from that published in the Toulouse Annales, namely, in the method of approximation. The most perfect method of approximation is that in which the integration of the differential equations is carried out completely, and approximations are introduced only in the applications. In Article 17 of the present paper the approximations are introduced in the differential equations; for instance, neglecting the square of the ratio which the velocity of the moving charge bears to that of light. By this means the labour of integration is reduced without loss of ultimate accuracy. In the last section a new case is considered, namely, that in which the velocity of the charge is the same as that of light, with the result that in this limiting case the presence of the conducting plane has no effect on the field produced by the moving charge. S. H. B.

2654. *Electromagnetic Vibrations of an Ellipsoid of Rotation.* **F. Ehrenhaft.** (Akad. Wiss. Wien, Sitz. Ber. 113. 2a. pp. 273–313, Feb., 1904. From the II. Physikal. Inst. der Univ., Wien.)—A highly analytical paper, in which are obtained expressions for the period, wave-length, and damping of the electromagnetic vibrations associated with a rotation ellipsoid differing but little from a sphere. E. H. B.

2655. *Electromagnetic Field near a Linear Oscillator.* **F. Hack.** (Ann. d. Physik, 14. 3. pp. 539–546, July, 1904.)—Taking the linear oscillator to be nearly equivalent to the rod-formed ellipsoid of rotation dealt with by M. Abraham, ten diagrams are given, showing, after the manner of Hertz, the field round the oscillator at various instants. E. H. B.

2656. *Electrical Vibrations on Thin Rods.* **Rayleigh.** (Phil. Mag. 8. pp. 105–107, July, 1904.)—Pollock rejects the simple theoretical result of Abraham and others, according to which the wave-length (λ) of the gravest electrical vibration associated with a thin, terminated conducting rod is equal to twice the length (l) of the rod, in favour of the calculation of Macdonald, which makes $\lambda = 2{\cdot}58l$. Abraham's investigation relates to the vibration about a perfect conductor in the form of an elongated *ellipsoid* of revolution, and he finds that $\lambda = 2l(1 + 5{\cdot}6\epsilon^2)$, where $1/\epsilon = 4 \log (l/b)$, $2b$ being the minor axis of the ellipse and l its major axis. Thus when $2b$ vanishes in comparison with l, we have $\lambda = 2l$. The present paper discusses from the theoretical aspect the question as to whether a result obtained for an infinitely thin ellipsoid can be applied to an infinitely thin rod of *uniform section*. The conclusion is "that the wave-length of the electrical vibration associated with a straight terminated rod of infinitesimal section is equal to twice the length of the rod, whether the shape be cylindrical, so that the radius is constant, or ellipsoidal, so that the radius varies in a finite ratio at different points of the length. And this conclusion still remains undisturbed, even though the shape be not one of revolution." E. H. B.

2657. *On Hollow Conductors.* **E. Almansi.** (Accad. Lincei, Atti, 13. pp. 12–19, July 3, 1904.)—The hollow conductor discussed in the first part of this paper may best be conceived as follows: Suppose a closed surface and a small piece cut out of it bounded by a line l. The remainder of the conductor, no longer closed, shall be denoted by σ''. The same line l bounds another surface ω, very small compared with σ'', so that σ'' and ω form a closed surface. We may then suppose another surface σ' also bounded by l, so that σ' and σ'' form a single closed surface σ, and so that σ' is wholly within the closed surface formed by σ'' and ω. At the same time ω is to be very small compared with σ'. On the conductor σ is then placed a charge of electricity E, whose potential when in equilibrium would be unity at each point on σ. The part of E which in equilibrium is on σ' is e. The problem is then to determine limits within which e must lie. If there be any other masses within σ, and V be their potential, and if h be the density of the equilibrium distribution (supposed fixed) at any point on σ, we have $\int Vh d\sigma = M$, where M denotes the sum of the other masses. If for these other masses we substitute a double stratum on σ, $M = 0$; therefore $\int Vh d\sigma = 0$. The writer then finds that if θ be the solid angle subtended by the internal face of ω at any point on σ, $e = \frac{1}{4\pi}\int \theta h d\sigma$, a result already obtained by Robin. And from it Robin finds that if θ_1, θ_2 be the minimum and maximum values of θ, $\frac{e}{E}$ lies between $\frac{\theta_1}{4\pi}$ and $\frac{\theta_2}{4\pi}$. The writer points out that we can obtain inferior and superior limits for e in an infinite variety of ways. For instance, let M_0 be a mass situated within σ, whose potential at each point on σ is equal to θ for that point; and let M_1, M_2 be two other masses within σ, whose potentials V_1, V_2 at any point on σ are respectively less and greater than θ. Then it is shown that M_0 lies between M_1 and M_2, and thence e lies between $\frac{M_1}{4\pi}$ and $\frac{M_2}{4\pi}$. It is shown further that if M_2, instead of being wholly within σ, is partly within and partly without σ, $e < \frac{M_2}{4\pi}$, provided the parts of M_2 external to σ be wholly positive. In conclusion he gives an example, namely, the line l is a plane curve, and ω a plane surface, which does not meet σ except in l. Let a be the radius, O the centre, of the least circle in the plane which encloses ω. Then $\theta < \frac{2\pi a}{\rho}$. Hence he deduces the following conclusion: "When a hollow conductor, which can be closed by a plane surface, contains electricity in equilibrium, and P is its potential, there will be on the internal surface a quantity of electricity less than half the product of P, and the radius of the least circle which can be described enclosing ω." S. H. B.

2658. *Electron Theory.* **W. Wien.** (Phys. Zeitschr. 5. pp. 393–395, July 15, 1904.)—In most researches on the theory of electrons an unchangeable spherical form is assumed for the sake of simplicity. The author, on the contrary, takes as the form of the electron what Searle has called a Heaviside ellipsoid. This has axes in the ratio $\left(1-\frac{v^2}{c^2}\right):1:1$, where v is its speed of translation and c that of light. Lorentz has already shown that by the assumption of this form for the electron the chief difficulties in the theory are surmounted, such as the negative results of the experiments of Michelson, Morley, Rayleigh, Brace, and Trouton and Noble. Also the experiments of Kaufmann on the magnetic and electric deflection of the β-rays are explicable on the hypothesis of the Heaviside ellipsoids. It is then shown that if this assumption explains some phenomena it also starts new subjects of inquiry. For example, at the speed of light each electron would have the form of a circular disc, and at higher speeds, according to this hypothesis, the charge of the electron would no longer be in stable equilibrium. [See also Abstracts Nos. 466 and 652 (1903), and 1481 (1904).] E. H. B.

2659. *Electrical Vibrations Associated with thin Terminated Conducting Rods.* **H. M. Macdonald.** (Phil. Mag. 8. pp. 276–278, Aug., 1904.)—This paper expresses the difficulties found by the author in the views adopted by Rayleigh [Abstract No. 2656 (1904)]. It is thought that the chief difference between the opposing views lies in the hypotheses relating to a free end and the position of the true loop with respect to it. "An important difference between the view supported by Rayleigh and that which regards the effect of the free ends as the essential feature, is that on the former view the damping of free vibrations on a terminated straight wire would not be very rapid, whereas on the latter it would. Now experiment would seem to show that such vibrations are very rapidly damped, and in fact theoretical considerations based on experiment indicate that the rate of damping of the free vibrations of longest period associated with a terminated straight wire is not very far removed from the order of magnitude of the known result, for a spherical vibrator." From some experiments of Pollock and theoretical considerations it is concluded that the free vibrations associated with a straight wire 152 cm. long have their amplitude reduced to $1/e$ of their value in about half a period. E. H. B.

2660. *Problems of Electric Equilibrium and Magnetic Induction.* **E. Almansi.** (Accad. Lincei, Atti, 13. pp. 72–79, July 17, 1904.)—We are to suppose a closed surface σ, convex, with finite radii of curvature at every point, and ϕ is the potential of a charge E of electricity distributed over σ, of which the density h is at every point finite and continuous. If ∂n be an element of the normal to σ measured inwards, we have at every point A on σ the equation $\left(\frac{\partial\phi}{\partial n}\right)_A = -2\pi h_A + \int_\sigma \frac{\cos\theta}{r^2} h\,d\sigma$, in which r denotes the distance from A to the element $d\sigma$, and θ the angle between r and n. Then $\int h\,d\sigma = E$. When E is in equilibrium $\frac{d\phi}{dn} = 0$, or writing now e for h, $2\pi h_A = \int \frac{\cos\theta}{r^2} e\,d\sigma$. From this formula Robin proved that if $f, f_1 \ldots f_n$ be a series of functions, satisfying the conditions of being finite and continuous at every point of σ, and $\int f d\sigma = E$, $\int f_1 d\sigma = \frac{1}{2\pi}\int \frac{\cos\theta}{r^2} f d\sigma$, and generally $\int f_n d\sigma = \frac{1}{2\pi}\int \frac{\cos\theta}{r^2} f_{n-1} d\sigma$, then limit $(n=\infty) f_n = e$. The writer now gives an independent proof of this proposition, assuming with Robin that the function e exists. It could, he says, be proved without this assumption by C. Neumann's method, but the work would be complicated. Having established this proposition, the writer proceeds to the problem of induced magnetism. A magnetisable body is bounded by the surface σ having the properties above mentioned. Outside are magnetised bodies having potential ψ. The potential of the induced magnetisation within σ is ϕ, and may be represented as the potential of a certain distribution on σ, and μ is the magnetic permeability. Hence he finds at each point A on σ, $\mu\left(\frac{d\phi}{dn}\right)_A + \left(\frac{d\phi}{dn'}\right)_A = (1-\mu)\left(\frac{d\psi}{dn}\right)_A$. If h be the density of the distribution whose potential is ϕ, we have $\left(\frac{d\phi}{dn}\right)_A = -2\pi h_A + \int \frac{\cos\theta}{r^2} h d\sigma$, $\left(\frac{d\phi}{dn'}\right)_A = -2\pi h_A - \int \frac{\cos\theta}{r^2} h d\sigma$, where dn' is an element of the normal measured outwards, whence substituting in the last equation we have—

$$h_A = \frac{\mu-1}{\mu+1}\left(\frac{1}{2\pi}\int \frac{\cos\theta}{r^2} h d\sigma + \frac{1}{2\pi}\left(\frac{d\psi}{dn}\right)_A\right).$$

He then writes $g = \frac{1}{2\pi}\frac{d\psi}{dn}$, and assumes a series of functions $g, g_1 \ldots$ &c., satisfying the condition $g_{n+1} = \frac{1}{2\pi}\int \frac{\cos\theta}{r^2} g_n d\sigma$, by which means h can be determined. The equation $2\pi h_A = \int \frac{\cos\theta}{r^2} h d\sigma + \left(\frac{d\psi}{dn}\right)_A$ is thus, he says, solved for the case of a body without charge. S. H. B.

2661. *Absolute Determination of Electric Conductivity and Specific Velocity of the Ions in the Atmosphere.* **H. Gerdien.** (Phys. Zeitschr. 4 pp. 632–635, Sept. 1, 1903.) *Measuring the Flow of Gases.* **H. Gerdien** and **H. Schering.** (Phys. Zeitschr. 5. pp. 297–298, June 1, 1904. Geophysikal. Institut., Göttingen.)—In gas mixtures we have to deal with at least as many different kinds of ions as there are constituents; the atmosphere is a mixture of gases and of water vapour whose concentration fluctuates, and we can therefore only speak of average mobility of the ions. The mobility is proportional to the charge of the ion, and inversely proportional to the frictional resistance which the electron, charged with the masses of the molecules, has to overcome in its motion through the gas mixture; the adsorption of water molecules would increase the friction. Experiments on the mobility near saturation are hence desirable. To measure the mobility in Ebert's aspiration apparatus part only of the ions should be withdrawn from the air; this can be done either by using very rapid air currents or by reducing the potential. Gerdien describes a portable apparatus in which an Exner-Elster-Geitel aluminium electrometer is combined with a condenser of variable capacity. Two sets of observations are required for determining the mobility of the ions of either polarity, first at high tension, then at low tension, while the conductivity can be derived from two single observations. The tube has a length of 60 cm., a diameter of 50 mm.; the average air speed is 410 cm. per sec. The specific mobilities found on the surface varied between 1·32 and 1·40 cm. per sec. for the positive ions, and between 1·52 and 1·75 for the negative ions. As to measurements made during the balloon ascents, see Abstract No. 1483 (1904). The second paper describes a simple anemometer used in these researches for determining the speed of the air currents. Owing to friction in the counting mechanism, ordinary anemometers record too low values for small speeds. The anemometer consists of two aluminium blades, attached to a diameter; the speed is determined stroboscopically, a disc with several rows of perforations in the ratios 1 : 2 : 4... being applied. Both the instruments are made by C. Diederichs, of Göttingen. H. B.

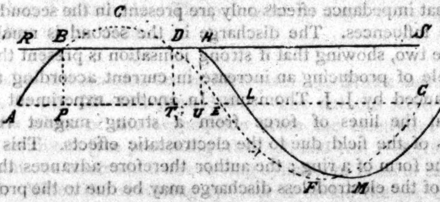
2662. *Head of Wave-Train from Hertzian Oscillator.* **A. E. H. Love.** (Roy. Soc., Proc. 74. pp. 73–83, Aug. 10, 1904.)—In Hertz's classic treatment of the electromagnetic radiation from a high-frequency oscillator no account of the damping was taken although it was known to exist. This lack was supplied by K. Pearson and A. Lee. But in both cases no special treatment of the wave-front was given. This is done in the present paper. Obviously the wave front is a moving surface, which is a surface of discontinuity in regard to the electric and magnetic forces. Within the surface these forces are expressed by known formulæ; outside the surface they must be expressed by other formulæ. The waves, in fact, advance either through a pre-established electrostatic or electromagnetic field of some kind, or through a region of space in which there are no electric or magnetic forces. Whatever view may be taken of the nature of the field outside the wave-front, definite conditions must be satisfied at this surface. These conditions are known and are here applied, thus modifying the results obtained by Pearson and Lee. The mathematical results then obtained are illustrated by twelve figures. [That we were ignorant of the phase at the wave-front was noticed by a pupil of Hertz in 1899. In work on the reflection and transmission of electric waves by condensers this factor was approximately allowed for.] [See Abstract No. 105 (1901).] E. H. B.

DISCHARGE AND OSCILLATIONS.

2663. *The Musical Arc.* **W. Duddell.** (Electrician, 51. p. 902, Sept. 18, 1903.)—This is a letter correcting certain misconceptions of the writer's views on the question of the pitch of the note emitted by the musical arc, and calling attention to the statement in his original paper [see Abstract No. 850 (1901)] to the effect that the resistance of the arc is for most purposes negligible, the pitch being given by the equation $T = 2\pi\sqrt{LF}$, but that the pitch is accurately given by the equation $T = \frac{2\pi}{\sqrt{\frac{1}{LF} - \frac{R}{4L^2}}}$. It is further pointed out that if the capacity F is small, oscillations take place when the resistance in the circuit is as great as 10,000 to 100,000 ohms. Again, for solid carbons, the writer finds that the p.d. falls with increasing current when the frequency is 1,000 ∿ but not when it is 100,000 ∿, and he concludes that the statements concerning very high frequencies which are sometimes made are erroneous. S. G. S.

2664. *Mechanism of the Production of "Duddell" Currents.* **O. M. Corbino.** (Atti dell' Assoc. Elettr. Ital. 7. pp. 597–606, Sept.–Oct., 1903.)—

Experiments performed by the author show that the current in the arc is never reversed. This fact accounts for the asymmetry generally exhibited by the current curve for the derived circuit, and explains the departure of the periodic time of oscillation from that calculated on the assumption that the current is sinusoidal. ACFG is the current curve for the derived circuit, assuming this to be sinusoidal, and RS is the current in the battery circuit. When the current which is charging the condenser reaches the valve BP the current in the arc is reduced to zero, and any further increase would mean a reversal of the current in the arc. Since this never occurs, the current curve becomes a horizontal straight line BH. When the condition D is reached the current again becomes sinusoidal and is represented by the curve HLMI, which is the curve DEFG moved forward through the distance DH. The current in the direction M is not limited, since the discharge current is in the same direction in the arc as the principal current. The area ABDHL is equal to the area ABCDE or LMI since each represents the charge acquired by the condenser at every oscillation. The result is that the periodic time AI is greater than that for sinusoidal current by the amount DH. By increasing the self-induction or diminishing the capacity of the derived circuit, or by increasing the length of arc, the current in the derived circuit may be reduced until it is as small as the principal current, in which case the oscillatory current becomes sinusoidal, the reason being that the point C falls below the line RS. A short account of the use of the "Duddell" current for measuring inductance is also given. [See also Abstract No. 1491 (1904).] S. G. S.



2665. *Conductivity of Flames.* **F. van den Bossche.** (Bull. Acad. Roy. Belg. pp. 864–887, 1903.)—The author has carried out experiments to test Arrhenius' assumption that vapours of the alkaline salts owe their conductivity chiefly to the dissociation of the water vapour present. The conductivity of a Bunsen flame coloured with common salt was measured both with and without the addition of water vapour; no difference was observed. With dry carbon monoxide no difference of conductivity between this and the coal-gas flame was noticed. It is, therefore, concluded that the presence of water vapour is unnecessary to the conductivity of a flame, thus confirming the view of Smithells, Dawson, and Wilson [see Abstract No. 574 (1899)]. The unipolar conduction was also examined, using a Beckmann arrangement. Salts of Na, K, Sr, Ba, Mg, Hg, ZnCu, Fe, and NH_3 were examined, and with a platinum plate and wire a larger current always passed with the plate negative than with the wire negative. The effect of salts was greatest for salts of monovalent metals, except ammonium chloride; the metalloids appear to have no influence, as also the concentration. Alteration of the applied voltage (from 1·7 to 46 volts) produced some effect with bivalent metals, hardly any with monovalent. The flame conductivity is not dependent on the unipolar conductivity. The latter is considered to depend on actions taking place at the negative electrode chiefly. [See also Abstract No. 1722 (1899).] L. H. W.

2666. *Electrodeless Discharge.* **A. Steiner.** (Akad. Wiss. Wien, Sitz. Ber. 113. 2a. pp. 403–406, Feb., 1904.)—Lecher has shown that some part of the electrodeless discharge arises from electrostatic influences. The latter are due to the ends of the coil attaining a large potential difference owing to the great impedance present with the rapidly alternating currents. He has left it open whether any part of the discharge arises from the changes in the electromagnetic induction. The author, a pupil of Lecher's, winds two tubes so that the same current passes round both. In the first the windings are arranged so that impedance effects only are present, in the second impedance and inductive influences. The discharge in the second is much the more vigorous of the two, showing that if strong ionisation is present the inductive effect is capable of producing an increase in current according to the view originally advanced by J. J. Thomson. In another experiment the tube is placed so that the lines of force from a strong magnet run parallel with the lines of the field due to the electrostatic effects. This causes the light to take the form of a ring; the author therefore advances the view that the ring form of the electrodeless discharge may be due to the properly timed magnetic field of the coil itself. The final conclusion is that inductive effects cannot start the current, but can largely increase it if sufficient ions are already present. R. S. W.

2667. *Electric Dispersion Produced by Röntgen Rays.* **P. Cardani.** (N. Cimento, 7. pp. 241–259, April, 1904. Ist. fisico, Univ., Parma.)—The electric dispersion is proportional to the energy available between the electrodes of the tube. The quantity of energy, which, being carried by the Röntgen rays, is expended in ionisation of the air traversed by those rays, is proportional to the amount of energy available between the electrodes of the tube; and with small capacities and small explosive distances the electric dispersion tends to be proportional to the same, whereas in the converse case it tends towards a limiting value. The condition most favourable to the production of Röntgen rays is to reduce the pressure until the general luminosity ceases; the discharge then becomes sharply active. For the same purpose the potential difference may be raised so long as the explosive distance is not made too great, larger sized tubes being of advantage in this respect. And thirdly, the tube should convey the maximum quantity of electricity consistent with an active form of the discharge. A. D.

2668. *Electromotive Force between Metals in Ionised Gases.* **F. Exner** and **R. Hofman.** (Boltzmann Festschrift, pp. 600–609, 1904.)—The e.m.f.'s between plates of various metals on polonium being introduced into the air-space between them were examined. The values for these, obtained with an electrometer, were found to be dependent upon the nature of the metallic surface, and the order in which they stand is, in general, the same as that for the metals in electrolytes. When previously ionised air instead of the polonium was passed between the plates the values were somewhat lower; with CO_2 or H in place of air only slightly different values were obtained. Radium salts gave similar values. The temperature had no effect on the e.m.f. L. H. W.

2669. *Arc between Mercury and Carbon.* **L. Cassuto.** (Phys. Zeitschr. 5. pp. 264–269, May 15, 1904.)—Determinations of current, electrode p.d., and distance between electrodes are made with mercury as kathode and carbon as anode and *vice versâ*, and the results are given in the form of curves. For any given current the p.d. is greater when the mercury is kathode than when it is anode. The curves are, to a first approximation, straight lines, which all cut the p.d. axis at the same point, indicating that the p.d. is the same for both directions of flow of current, when the length of gap is reduced to zero. Hence the difference is due to the column, more mercury vapour being present when the mercury is anode than when it is kathode. This explains an experiment of J. E. Ives [see Abstract No. 2687 (1904)], in which it is found that the capacity used as shunt to reduce the spark between a metal and mercury on breaking circuit is greater when the mercury is anode than when it is kathode. The p.d. must be much more reduced in the former case than in the latter. S. G. S.

2670. *Electric Arc between Cooled Electrodes.* **J. Stark** and **L. Cassuto.** (N. Cimento, 7. pp. 425–437, June, 1904.)—The authors have continued to investigate the effect of the evaporation from the electrodes on the p.d. between the terminals [see preceding Abstract, and No. 1736 (1904)]. In the first experiment one electrode is a revolving cylinder of brass or carbon and the other is fixed. When the revolving cylinder is anode the arc can be maintained, but this is not the case when it is kathode, the reason being that the kathode is then effectually cooled, and hence no evaporation takes place from it. A similar result was found when using a carbon rod for one electrode and a tip of iron resting on a water-cooled cylinder of brass for the other. In this case small current and high voltage were used. In the second set of experiments a concentrated solution of zinc sulphate is used for one electrode and a carbon rod for the other. An arc can be maintained when the liquid is anode, but not when it is kathode. The authors make use of this phenomenon to explain the unipolarity of the Wehnelt interrupter. When the platinum is kathode an arc is set up, the gradual quenching of which gives rise to an irregular and gradual interruption of the current; but when the liquid is kathode the current can only pass as a sudden discharge, no arc being possible. The authors then experimented with copper electrodes and determined the relation between p.d. and length of arc, both for cooled and for uncooled electrodes. The curves approximate somewhat to straight lines whose slope is greater for cooled than for uncooled electrodes, the reason for which is that there is less vapour in the arc in the former case than in the latter. Experiments on the deformation of the surface of electrodes are described. In the case of liquid electrodes there is a deformation due to the pressure exerted on account of the rapid formation of vapour. S. G. S.

2671. *Chemical Influence of Kathode Rays.* **E. Bose.** (Phys. Zeitschr. 5. pp. 329–331, June 15, 1904.)—It is sought to determine whether the chemical influence of the rays follows Faraday's law. Kathode rays are shot at the surface of a solution of caustic potash and the mixed gases are collected and examined. In series with the discharge tube is a hydrogen voltameter. If Faraday's law is followed the amounts of hydrogen liberated in the two vessels should be equal. It is found, however, that the rays liberate 10–30 times as much gas as appears in the voltameter. This is ascribed to the kinetic energy of the rays. Assuming that all their energy reappears as heat of dissociation, a calculation is given showing that 1,600 times the amount of hydrogen in the voltameter should appear in the discharge vessel. There are other forms in which the kinetic energy could be absorbed, such as heating the solution, &c., by which means the hydrogen liberated could be reduced to the amount experimentally found. R. S. W.

2672. *Expulsion of Negative Ions by Metallic Oxides.* **A. Wehnelt.** (Ann. d. Physik, 14. 3. pp. 425–468, July, 1904. Physikal. Instit. Erlangen.)—When heated to a dull red heat various oxides are found to give rise to a large number of negative ions. The oxides of the alkaline earths are most efficient, but various members of the magnesium group and some of the earthy metals also possess this property. Along the axis of a metal cylinder a thin platinum wire is stretched, and this is covered with the oxide to be tested. The wire is heated by passing a current along it, the saturation current between wire and cylinder being measured by a delicate galvanometer. At low temperatures a pure platinum wire sends out more positive ions than negative, at about 1,400° positive and negative are equally numerous; above this the negative predominate greatly. The oxides alter the number of positive ions very little, but even at 970° the current carried by negative ions is four times as large as that carried by the positive. The formula given by Richardson for hot platinum is found to hold, viz., $N = A\theta^{\frac{1}{2}}e^{-\frac{b}{\theta}}$, where A and b are constants, θ is the absolute temperature, and N is the number of ions emitted. N is 1,000 times greater than for pure platinum in some cases. If the heated oxides are used as kathodes in a Geissler tube, the kathode fall is very greatly reduced. In one instance, when BaO covered a sheet of platinum 2 cm. square, 110 volts produced a current of 3 amps., the pressure being 0·01 mm. If the current density is sufficiently increased, a point is reached where the kathode fall is increased. This is the case when the negative ions are all removed by the field as fast as they are emitted. The small kathode fall makes it possible to produce kathode rays and canal rays under a very low potential. By measuring the magnetic deflection e/m is obtained and is found to lie between $1{\cdot}34 \times 10^7$ and $1{\cdot}8 \times 10^7$. These numbers are very rough. R. S. W.

2673. *Discharge through Gases and the Electric Arc.* **E. Rasch.** (Phys. Zeitschr. 5. pp. 375–379, July 1, 1904.)—A consideration in the case when the electrodes are of second-class conducting power. The effects of electrode distance and electric pressure are considered. J. W. P.

2674. *Point Discharge in Homogeneous Electric Field.* **K. v. Wesendonck.** (Phys. Zeitschr. 5. pp. 399–403, July 15, 1904.)—The effect on the discharge p.d. of the shape of that part of the conductor lying around the point is investigated. An insulated metal plate is charged and connected with the electrometer. An earthed plate which is parallel to it is provided with an insulated needle which may be either earthed or connected to an electrometer. The rate of fall of potential of the insulated plate is a measure of the current passing between it and the point. The point can be adjusted to stand out at various distances from the earthed plate, and for each distance the potential at which the discharge ceases is measured, the distance of the point from the insulated plate being recorded. It is found that the discharge continues at much lower potentials when the point stands out a great distance from the earthed plate than when this distance is small. In the latter case the electrical field is nearly uniform. Hence the great effect of the shape of the surrounding country on the efficiency of a lightning conductor. It has been suggested by Arrhenius that the gases arising from chimneys are able on account of their conductivity to partially discharge a thundercloud. The author investigates this point by producing discharge of the insulated plate by means of a Bunsen burner underneath it; in fact, to replace the point in the last experiment by a lighted burner. When the burner is close to the plate the discharge is rapid, the potential of the burner rising quickly. The effect falls off rapidly as the distance of the burner from the insulated plate is increased, and the author concludes that the effect mentioned by Arrhenius must be very small, if indeed it is present at all. S. G. S.

2675. *Ionisation and the Formation of Ozone.* **S. Guggenheimer.** (Phys. Zeitschr. 5. pp. 397–399, July 15, 1904.)—An experiment is described in which numbers are obtained representing the relative conductivity of air in the presence of yellow phosphorus, using alternately moist and dry air. The numbers are 40 and 16, the number obtained when no phosphorus is present being 14. These numbers represent the diminution in deflection of the electrometer needle in 10 min., the original deflection being 125 scale divisions in each case. Thus 14 represents the conductivity due to faulty insulation, 40 the sum of this and the conductivity due to ionisation in moist air, and 16 the same for dry air. The author is of the opinion that the deviation from the law of mass action which the oxidation in the above case shows is intimately connected with the ionisation observed, and that this deviation is apparent rather than real. He thinks that higher oxides, such as P_2O_7 and P_2O_9, are formed, which on splitting up give ozone. He has also shown that ozone has no action on the photographic plate. S. G. S.

2676. *Point Discharge.* **E. Warburg.** (Deutsch. Phys. Gesell., Verh. 6. 14. pp. 209–210, July 30, 1904.)—A point, from which negative electricity is streaming, is observed under a microscope, the surrounding gas being at atmospheric pressure. The point itself is seen to be covered with a bluish light (*a*), followed by a dark interval (*b*), which is succeeded by a broader, reddish light (*c*). The author thinks that these correspond to the different parts of the discharge which are seen at reduced pressures. Thus (*a*) corresponds to the negative glow, (*b*) to the Faraday space, (*c*) to the positive column. R. S. W.

2677. *Quasi-Radio-activity produced by the Point Discharge.* **S. A. Edmonds.** (Cambridge Phil. Soc., Proc. 12. pp. 469–473, Aug., 1904.)—The quasi-radio-activity produced by the action of the point discharge, described by Sella [see Abstract No. 2048 (1902)], was investigated by the author and found to be due to the presence of dust particles in the air. Discs of various metals were prepared which could be fixed to the terminal of a 6-plate Wimshurst machine, and opposite the disc was arranged a set of insulated needles about 10 cm. from the disc; these during the discharge just showed small brushes at the points. The radio-activity of the discs was afterwards tested. The dust particles come into contact with the stream of ions present, moving from the points to the plane, carrying the discharge, and, when they become deposited on the plane, trap some of these ions and hold them, so that they can only enter very slowly indeed into the metal of the disc under the force of attraction they experience by virtue of the charges carried by them. The disc thus has a film of ions held in the dust deposit on its surface, so that, if it be placed in the testing vessel and raised to the potential employed in the experiments, the electric field produced will act upon the ions thus trapped and increase their energy, thus enabling them either to go out from the disc and into the electrode facing it, thereby increasing the charge in the electrometer, or else to go into the metal of the disc, and so show no external effects. When the disc is at the positive terminal during the discharge from the points, it will attract negative ions to itself, so that, in this case, some of these negative ions should get trapped by the dust, to be liberated when the disc is placed in the testing cylinder and raised to a negative potential, while, on the other hand, when the disc is at the negative terminal of the machine it will attract to itself positive ions, and consequently will, when placed in the testing cylinder, leak positive electricity. J. J. S.

2678. *Magnetic Deflection of Negative Current of Electricity from a Hot Platinum Wire at Low Pressures.* **G. Owen.** (Cambridge Phil. Soc., Proc. 12. pp. 493–509, Aug., 1904.)—The current of negative electricity from a hot platinum wire at low pressures is mainly carried on by corpuscles, the proportion of which to heavy particles is at least 4 to 1. From 10 to 20 per cent. of the discharge from an uncleaned wire, and also from a wire which has been cleaned by boiling in nitric acid, is carried by heavy particles; but by prolonged heating of the wire and frequently renewing the air in the apparatus, this proportion can be reduced to 5 per cent. even for very high temperatures. At low temperatures the discharge is wholly carried on by corpuscles whose e/m is $1{\cdot}41 \times 10^7$. The negative discharge appears due primarily to the ionisation of gases (probably hydrogen) occluded in the wire, and is for any given temperature proportional to the amount of gas in the wire. When the wire is heated the occluded gases slowly escape, the rate of escape diminishing with continued heating, and the metal is disintegrated by the gas carrying away particles of the metal as and when it escapes. A small fraction of the discharge is carried by the molecules of gas and particles of platinum emitted by the incandescent wire. A. D.

2679. *Conduction in High Vacua.* **R. J. Strutt.** (Phil. Mag. 8. pp. 157–158, Aug., 1904.)—From experiments on a rod of bismuth made active by a deposit of "radio-tellurium" and placed in an exhausted tube it was shown that even in high vacua there is a loss of electricity from a charged body in presence of the α-rays, independent of traces of residual gas. This effect prevents detection of the charge of the α-rays. J. J. S.

2680. *Effect of Screening on Ionisation.* **A. Wood.** (Cambridge Phil. Soc., Proc. 12. pp. 477–480, Aug., 1904.)—It is found that the proportionate reduction due to a given screen, of the ionisation in a closed vessel is not the same for vessels of different materials. This is presumptive evidence that the ionisation in a closed vessel is in part produced by a radiation from the walls, which is independent of the penetrating radiation from without. This intrinsic radiation is great in lead and aluminium, and small in iron, zinc, and tin. J. J. S.

2681. *Discharge of Electricity from a Nernst Filament.* **G. Owen.** (Phil. Mag. 8. pp. 230–258, Aug., 1904.)—The principal results of the experiments carried out are as follows: From a glowing Nernst filament there is at all pressures a discharge both of positive and negative electricity. The negative leak behaves in a perfectly regular way, diminishing only slowly with the time, and is not liable to those sudden variations which occur in the case of the negative leak from platinum. The negative leak at certain pressures shows the effect of ionisation by collision. The negative leak when no ionisation by collision occurs, increases as the pressure is diminished until a pressure of a few mm. is reached. It then remains constant down to a low vacuum. The negative leak increases rapidly with the temperature of the filament. At low pressures for a considerable range the negative leak under a high potential is proportional to the pressure. From a filament which has not been heated before, there is a large initial positive leak which rapidly dies away. After long-continued heating of the filament the positive leak becomes fairly steady, but still continues to diminish with the time. The positive leak increases with the temperature of the filament, but not so rapidly as the negative leak. The carriers of the negative leak in a vacuum are corpuscles, while the carriers of the positive leak are particles of molecular dimensions. J. J. S.

2682. *Lead Peroxide Coherers.* **E. Drago.** (N. Cimento, 6. pp. 197–200, Sept., 1903.)—In PbO_2 coherers electric waves, if weak, cause gaps to bridge over, and the resistance diminishes; when the waves are powerful, the bridges break down and the resistance increases. Mechanical jars break down the bridges. The finer the powder the more distinct is the action. Under the conditions in which the PbO_2 coherer falls in resistance, metallic stratiform coherers are of small sensitiveness. A. D.

2683. *Propagation of Electric Waves along Spiral Wires, and Appliance for Wireless Telegraph Wave-length Measurement.* **J. A. Fleming.** (Phil. Mag. 8. pp. 417–437, Oct., 1904. Electrician, 53. p. 878, Sept. 16, 1904. Abstract. Paper read before the British Association (Section A), at Cambridge, 1904.)—The author deals theoretically and experimentally with the propagation of electric waves along spiral wires and with the use of rarefied neon in tubes for detecting the anti-nodes and thus the internodal distance. A helix of 5,000 turns on a wooden rod of length 200 cm. (wound in one layer), had an inductance of 100,000 cm. per cm., the capacity being 7/40 micro-microfarad. From these values the propagation of waves along the helix is shown to be 235×10^6 cm. per sec. This was confirmed by taking the half wave-length when the first harmonic oscillation was formed on the helix ($\frac{1}{2}\lambda = 140$ cm.), and the frequency calculated from the capacity and inductance was $0{\cdot}847 \times 10^6$, the product giving the above value for the velocity of propagation as calculated from the constants of the helix. A form of this helix is then described, resembling somewhat in principle the apparatus of Seibt. In this case the single layer of wire is wound on an ebonite rod supported on an insulating stand. One end of the helix is provided with an insulated metal plate placed facing another plate connected to the oscillating circuit to be measured. A metal saddle connected to an earthed wire is slid along the helix until the neon tube shows a node half-way between the saddle and the plate; this distance is then one wave-length of the stationary wave. From the constants of the helix the frequency can then be derived. The instrument can also be used for measuring small inductances and very high frequencies, as has been pointed out by Slaby. [See Abstract No. 2093B (1904).] The luminescence of the neon tube can be seen even in daylight. L. H. W.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

2684. *Change of Electrical Resistance of Soot, Tellurium, Metals, &c., under the Influence of Light.* **L. Ancel.** (Zeitschr. Elektrochem. 9. pp. 695–696, Aug. 20, 1903. Report read before the 10 Hauptversamml. der Deutsch. Bunsen Gesell., June 3–8, 1903, at Berlin.)—The resistance of selenium is very sensitive to the influence of light, but it has certain disadvantages for use in radiophonic receivers—it is dear, has a high resistance, often shows irregular conducting properties, &c. Soot is free from these objections, but is less sensitive to light than selenium. Selenium coated with soot has, however, a much greater sensitiveness than either of the bodies separately. As regards the change of electrical conductivity, heat and light have opposite effects in the cases of tellurium and thin metal plates, but act in the same direction for soot and selenium. With reference to the change produced in these substances by the action of light, chemical analysis indicates no molecular change, nor do the physical properties undergo alteration. The author's investigations lead him to the view that this action of light is similar to that of the Hertz waves on the auto-decohering coherers used in wireless telegraphy. A kind of unstable molecular equilibrium would then be produced, and this disappears rapidly, but not suddenly, after the light-action ceases. T. H. P.

2685. *Magneto-elastic Detector.* **A. Sella.** (Accad. Lincei, Atti, 12. pp. 182–188, Sept. 6, 1903.)—A summary of researches leading up to Marconi's magnetic detector. [See Abstract No. 1060 (1903).] The author shows that a detector, of less delicacy, may be made by applying his discovery that the magnetic state of iron is sensitive to electric waves when the hysteretic cycle is due to elastic deformation instead of to variations in an external field. A. D.

2686. *Design of Ballistic Galvanometers.* **P. H. Powell.** (Elect. Rev. 53. pp. 492–493, Sept. 25, 1903. Paper read before the British Assoc. (Section A) at Southport, Sept. 15, 1903.)—The equation of motion of the moving parts of the suspended-coil galvanometer is obtained, and it is shown that for long period and high sensitiveness a fine suspension strip must be used, so that the control shall be as small as possible. The critical resistance as regards damping is calculated for a particular instrument. Because of the effect of traces of iron in the copper wire, the coil was made very narrow and placed in a uniform field, the damping being produced by the effect of an electromagnet on a copper disc which hangs below the instrument and is rigidly attached to the coil. This disc also serves to increase the moment of inertia of the moving parts. S. G. S.

2687. *Law of the Condenser in the Induction Coil.* **J. E. Ives.** (Phil. Mag. 6. pp. 411–417, Oct., 1903.)—The formula for the optimum capacity in an induction coil, previously given by the author [see Abstract No. 390 (1904)], does not hold for moderate speeds of break, so that the relation between such optimum capacity and the other constants of the primary, viz., the current, resistance, and inductance has been sought experimentally. A primary without core, of inductance 0·28 henry, and without secondary was used, and the break consisted of a 1 mm. diam. amalgamated copper wire dipping into a cup of mercury. The breaking was done by hand, and the capacity around the break increased until the sparking disappeared or became small. The results are given in the form of tables and curves, and are summarised by the author as follows : The optimum capacity depends on the sign of the breaking pole (greater for $-$ than for $+$) and is, in general, proportional to a power of the primary current ($> 2 < 3$). It depends noticeably on the resistances of the connections leading to the break and to the condenser, and is a function of the inductance of the primary, but for large inductances becomes practically independent of it. L. H. W.

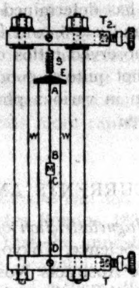
2688. *Electrocapillarity.* **J. Billitzer.** (Akad. Wiss. Wien, Sitz. Ber. 112. 2a. pp. 1553–1594, and pp. 1734–1751, Dec., 1903.)—On the principle of Nernst's theory that in a drop-electrode ions of mercury deposit on the falling drops of mercury or leave it according as the solution-tension of the mercury is less or greater than the ionic pressure in the surrounding solution of mercury, and in the light of Palmaer's experiments with auxiliary mercury electrodes [see Abstract No. 1226 (1899)], the author devised a method for ascertaining potential-differences between the mercury drops and the solution from changes in the concentration of the solution near the mercury drops. These potential-differences must present a zero value, at which there is no change in the concentration of the solution. A cell made up of mercury, a mercury solution such as presents the above zero value, and a constant electrode gives the absolute potential-difference between that mercury solution and that electrode; for the potential-difference Hg | solution $=0$; and this, ascertained for one electrode, enables the absolute potentials of all combinations to be ascertained. In practice it is easier to find points above and below the zero. In $HgCy_2$ solutions the sign of the potential-differences changes when the drops of mercury cease—a result which cannot be explained by diffusion; the p.-d. then reached does not depend on the previous rapidity of dropping, &c., whereas during dropping it varies with the pressure behind the mercury-jet and depends apparently upon the conditions of the formation of the drops. The p.-d. after the dropping ceases represents the differences produced in the concentration of the solution. The absolute zero point lies at about $-0{\cdot}4$ volt. The p.-d. also depends upon the capacity; with greater capacities the absolute zero point corresponds to more dilute cyanide solutions. Anomalies are caused by the potential-gradient between the dropper and the mercury collected below; the drops as they fall become positively charged, since the surface-tension of mercury is greater than it becomes when the drops leave the nozzle and fall through the solution; the solution-tension of the mercury also changes. Amalgamated gold wire loses or gains mercury in the same way as metallic mercury. These results are at variance with Helmholtz's theory, according to which the double layer disappears when mercury attains its maximum of surface-tension. Pellat's experiments (Comptes Rendus, 104. p. 1099) were therefore repeated and were unexpectedly found to be also at variance with that theory. There is a change of sign of p.-d. when the author's absolute zero point is being passed; at that point a mercury electrode is non-polarisable and its surface-tension is scarcely variable. According to Helmholtz the vertex of Lippmann's almost parabolic curve for potential-difference (in sulphuric acid) and surface-tension represented a p.-d. Hg | acid $=0$ and the absence of any double layer, with its mutual repulsion of the two sheets and tendency further to expand the surface-area. By means of a cycle of operations the author finds $d\gamma = -k \,.\, de/ds \,.\, d\pi$ where γ is the superficial tension, e is the charge, s is the area of the drop, and π is the absolute potential-difference. From this relation between surface-tension γ and potential-difference π there follows a relation between surface-tension and solution-tension (as also the superficial vapour-tension), which increase together. If we polarise a mercury meniscus (as a kathode), surface-tension and solution-tension both increase and the mercury tends to dissolve; and conversely if the mercury be made an anode. But there is also, with each change of p.-d., an electrostatic pressure which tends to diminish the surface-tension. Since (Lippmann's curve) $\gamma = \text{const.} - b\pi^2$, $d\gamma = 2b\pi d\pi$; whence $d\gamma = -k \,.\, de/ds \,.\, d\pi - 2b\pi d\pi = -a d\pi - 2b\pi d\pi$ if de/ds be kept constant; whence $\gamma = \gamma_0 - a\pi - b\pi^2$. In this, γ_0 is the superficial tension when $\pi = 0$, not the maximum superficial tension. The curve is unsymmetrical, and its vertex is not at $\pi = 0$ but at $\pi_{max.} = -a/2b$, and the double layer does not disappear at the apex of Lippmann's curve. That curve is, however, not truly a parabola, and b is not constant, except fairly so at the middle of the curve; its variations are great when π is very small. The factor a, on the other hand, is fairly constant. Helmholtz's theory did not explain how the maximum surface-tension of mercury differed so greatly in different liquids. On the present theory γ ought to be the same whenever $\pi = 0$, that is at the absolute zero point of potential-difference; but experiments to confirm this have not been very successful, on account of the formation of a skin on the mercury. In drop-electrodes the p.-d. can be no other than that between an electrolyte and a mercury electrode at its maximum superficial tension. Work has to be done against superficial tension; this is a fraction of gravity, $-q dh = d(\gamma s) = \gamma ds + s d\gamma$ (since γ is variable); and since $d\gamma = -a d\pi - 2b\pi d\pi$, we find—

$$\frac{d\pi}{ds} = \frac{\gamma + q\,\frac{dh}{ds}}{a + 2b\pi}$$

A constant-dropping drop electrode works the potential-difference up to a maximum when $\pi = -a/2b$. The new equation represents Lippmann's curve well enough, since $b\pi^2$ is very small when π is great; and it accounts for the asymmetry of the curve, the shift of its maximum, and the working of drop-electrodes. [See also Abstract No. 148 (1904).] A. D.

2689. *Optical Method of Measuring Current.* **E. Orlich.** (Zeitschr. Instrumentenk. 24. pp. 65–70, March, 1904. Communication from the Physikalisch-Technische Reichsanstalt.)—The method, which is used especially for testing instruments for alternating currents, consists in causing to pass through a strip of platinum-foil, first a direct current so that it is heated to redness, then the alternating current which is to be measured so that the platinum strip is heated to the same temperature. If the conditions are the same the two quantities of current must have the same heating value, The method is thus a comparison of the alternating current with the known direct current. The adjustment of the temperature of the platinum strip so that it is the same in each case is carried out with the help of a Holborn and Kurlbaum optical pyrometer [see Abstracts Nos. 2122 (1901) and 1196 (1903)] whereby the colour of the platinum strip is matched by the colour of the filament of a small glow lamp. In an actual experiment the following procedure is adopted; first of all a continuous current of about the strength of the alternating current to be determined is sent through the platinum strip; the colour of the glowing strip is exactly matched in the filament of the glow lamp in the pyrometer. The direct current is measured and then stopped and the alternating current sent through the strip and is adjusted in strength until the platinum is heated to exactly the same colour as before. The direct current is again put through afterwards in case of any change. In this way alternating currents can be measured to within 0·3 per cent. The platinum strips are about 15 mm. wide and may be used for currents of from 20 to 270 amps. depending on their thickness. For stronger currents the author recommends platinum tubes. E. C. C. B.

2690. *Instruments for Measuring Alternating Currents.* **W. Duddell.** (Phil. Mag. 8. pp. 91–104, July, 1904.)—Two novel forms of instrument for the measurement of small alternating currents are here described; they are practically inductionless, and so can be used when the currents are of very high frequency. The first (see Fig.) consists of an Ayrton-Perry twisted strip, A B C D, of which the part A B is twisted the opposite way to C D, and a mirror M with a very thin mica damping vane fixed at its centre. This strip is stretched in a frame formed of a brass block T, carrying one terminal and a piece of ebonite E, the sides of the frame being formed by the wires W W. This frame itself is stretched by a spiral spring S. The twisted strip and the wires are made of the same metal, so that as atmospheric temperature rises the whole frame gets longer. When a current is sent through the strip it alone heats up and twists, rotating the mirror M. Owing to the fineness of the strip (0·001 in.) the instrument is very quick in action; the mechanical time period is also very short, so that it is able to follow with fair accuracy currents that vary over a small range as rapidly as 1 or 2 cycles per sec. It measures the root of the mean square of the current, and can be calibrated with continuous currents. The second instrument is much more delicate and sensitive. A Boys radio-micrometer, but with a much smaller suspended loop than usual, and without a radiation-receiving plate, has a small length of wire (through which the current to be measured is passed) placed directly underneath the lower thermojunction, so that this junction receives heat both by radiation and convection. As examples of the sensibility, on making a suitable noise into a Bell telephone-receiver sufficient current is generated to send the spot of light off the scale; and if the thermogalvanometer be connected to the line wires of a microphone transmitter arranged in the ordinary way, whistling at a distance of 15 to 20 ft. from the microphone will cause deflections of several hundred scale divisions. A commercial form of this second instrument is also described. For large currents shunts are used.



E. C. R.

2691. *Forced Vibrations of a Mercury Drop in an Electrolyte.* **P. G. Gundry.** (Ann. d. Physik, 14. 3. pp. 590–601, July, 1904.)—The experiments were undertaken with the intention of determining the surface tension of mercury in an electrolyte. The method used by Rayleigh and by Lenard, of observing the oscillations in shape of a falling drop is here modified. The drop is produced at the upper end of a capillary tube, and an alternating current passes between the drop and the dilute sulphuric acid by which it is surrounded. This causes the state of polarisation, and therefore the surface tension of the mercury to vary periodically; and if the frequency of the current coincides with the frequency of one of the natural vibrations of the drop, resonance occurs. In this way can be set up in the drop the fundamental vibration, or one of the harmonics. The size of the drop, and the frequency and strength of the alternating current, can all be varied at will. The drop is photographed in various phases of its vibration, the illumination being produced by a spark actuated by an electrically driven tuning-fork. The periodic time of vibration of a sphere of liquid of volume V and density ρ, in a fluid of density σ, when α is the surface tension, has been given by Rayleigh as $\sqrt{\frac{3\pi V}{\alpha}\cdot\frac{(n+1)\rho+n\sigma}{(n+1)\,n\,(n-1).(n+2)}}$, where n may be any natural number from 2 upwards. The author has determined the frequency and volume of the drop when $n=2$, $n=3$, and $n=5$, and finds a fairly good agreement between the calculated and observed ratios of the frequencies when $n=2$ and $n=3$. The agreement is not quite so good for the ratios when $n=3$ and $n=5$. Photographs of a drop in various phases, when the first harmonic ($n=3$) is predominant, are given. S. G. S.

ALTERNATING CURRENTS AND MAGNETISM.

2692. *Magnetisation and Magnetostriction of Nickel Steels.* **H. Nagaoka** and **K. Honda.** (College of Science, Tokyo, Journ. 19. 11, pp. 1–13, 1903.)—Guillaume and Osmond [see Abstracts Nos. 1550 and 1551 (1902)] have discussed former researches by the authors, but as only four different percentages of nickel were used, no final conclusion could be drawn from that work. Eight new specimens are now used, and results are given for eleven different percentages of nickel (from 70 per cent. to 24 per cent.). As regards magnetisation, 50 per cent. nickel has the greatest permeability, while 24 per cent. nickel has the least, though there is a minor maximum point for 29 per cent. nickel. As regards change in length, 46 per cent. nickel shows the greatest expansion, while 24 per cent. has no expansion. Some percentages have linear relation between H and δl, while some are of the form of the well-known B-H curves for iron. [See also Abstract No. 167 (1904).] P. E. S.

2693. *Force on Magnetic Particles in Magnetic Field.* **A. Anderson.** (Phil. Mag. 8. pp. 38–42, July, 1904.)—A small particle of soft iron, or a small magnet, when placed in a magnetic field is usually acted on by a force in the direction in which the intensity of the field increases most rapidly. This is, in general, only true when the field is conservative. Thus, in the case of a current of electricity in a straight wire or cylindrical liquid column of circular cross-section, the force on a particle of soft iron *inside* is in the direction in which magnetic intensity *diminishes* most rapidly. The general case is also analytically solved. E. H. B.

2694. *Magnetic Susceptibility of Alloys of Tin and Bismuth.* **S. C. Laws.** (Phil. Mag. 8. pp. 49–57, July, 1904.)—The specimens used are pure bismuth and four alloys, having 1, 3, 10, and 23 per cent. tin with the bismuth. Von Effingshausen's method is used, viz., to measure the mechanical suction set up when the specimen is half in and half out of a coil carrying a current. The force is measured on a sensitive balance, and by using a mirror attached to the free end of the balance pointer it is possible to get 800 divisions movement of the scale when 1 m.gm. is put on the balance. Very consistent results are obtained. All the specimens are diamagnetic, but the addition of tin causes a reduction in the diamagnetic property of bismuth. The general law is that when a small amount of tin is added a considerable change in all physical properties (including susceptibility) of bismuth occurs. But the addition of bismuth to pure tin produces a gradual change in properties.
P. E. S.

2695. *Effect of Annealing on Magnetic Change of Length.* **S. Bidwell.** (Roy. Soc., Proc. 74. pp. 60–63, July 19, 1904.)—In a paper to the Royal Society in 1894 the author showed that annealing iron has the effect of changing very considerably the curve for its change of length when magnetised. In the present paper results are given in the cases of nickel and cobalt. Annealing nickel causes a small change such as would occur if it were rendered more susceptible. Cobalt, however, behaves in a peculiar way. A cast specimen when annealed, gives a curve of contraction uniformly increasing, showing no point of inflection or maximum. A rolled specimen when annealed contracts for weak fields more rapidly than when unannealed, and then expands again. P. E. S.

2696. *Magnetic Viscosity in Commercial Soft Steels and Effect on Measuring Methods.* **R. Jouast.** (Comptes Rendus, 139. pp. 272–274, July 25, 1904.)—It is pointed out in this paper that the annealed soft steels now commonly used show the phenomenon of magnetic viscosity in very marked degree. In studying the magnetisation of a 2-cm. thick iron ring by the ballistic method, on varying the field from the maximum, H = 98 gauss, to a value H = −1·1 (value of the coercive force), the galvanometer put in circuit 9 sec. after the change of field was made, gave a deflection. The maximum duration of this effect is round about the region of the coercive field, but it can be observed from H = +1·1 to H = −9. Similar effects are noticed when tracing the curve by successive steps; in such measurements the errors are cumulative, and quite erroneous values are obtained. To obviate this source of error it is recommended that the ballistic measurements should only be made with *increasing* fields. The method is only applicable for values of H, such that the steel is nearly saturated. L. H. W.

2697. *Law of Action between Magnets and its Bearing upon the Determination of the Horizontal Component with Unifilar Magnetometers.* **C. Chree.** (Phil. Mag. 8. pp. 113–145, Aug., 1904. Communicated by the Physical Society.)—The author discusses the fundamental formulæ given by Lamont and worked out by Börgen, and the influence of the higher constants depending upon the dimensions of the magnets and their distribution of magnetism. He shows how the horizontal force can be determined, when these constants are not negligible, and deals with errors in setting up the deflecting magnet, in deflection distances, and in deflection angles. The observational results given for the coefficients and the experiments on pole distance concern magnets of Jones (fifty years old, not remagnetised), the Cambridge Instrument Co., Cooke, Dover, Elliott. The Kew magnets have all been in use for a generation; mere age might possibly increase the pole distance. Börgen's ratio, pole distance to length of magnet = 0·805 (0·815 in very weak magnets), is on the whole confirmed. Special experiments with collimator magnets and with mirror magnets and on their interaction would be desirable.

H. B.

ELECTROPHYSIOLOGY AND ELECTROTHERAPEUTICS.

2698. *Intermittent Currents of Low Tension.* **S. Leduc.** (Archives d'El. Médicale, 11. pp. 521–535, Sept., 1903. Communication made to the Congrès d'Angers de l'Association franç. pour l'avancement des Sciences, Aug., 1903.)—The interrupter employed is of the Contremoulin-Gaiffe type. On an axis driven by a small dynamo an insulating disc is mounted, around the circumference of which four pieces of copper are fixed. Each piece of copper is insulated from its neighbours by an intervening portion of the circumference of the disc, and has metallic connection with the piece opposite to it. The current is carried by two brushes which are in contact with the circumference of the disc, of these one is movable. By altering the relative position of the brushes the relation between the duration of the passage of the current and the duration of the interruption can be altered at will. A rheostat in the circuit of the dynamo allows the speed to be regulated and at the same time the number of interruptions per sec. proportional to this speed. The author has arrived at the following conclusions: In the physiological action of the current the electrical dimensions, potential, intensity, are subordinated to the duration of each passage of the current, and may be represented by a curve of which the abscissæ are proportional to the duration of passage, and the ordinates to the electrical dimension under consideration. The electromotive force necessary to produce a given muscular contraction reaches a minimum when the duration of the passage of the current is 0·001 sec. The duration of the interruptions of the current influences the form of the contractions; it must have a certain minimum in order to produce tetanisation; if it is very short, closure causes a jerk like that of the constant current. For intermediate durations there are two contractions for each closure, firstly a jerk and then, during the fall from this, a tetanic contraction. The exciting action of an electric current is not the same at the different points of the same circuit; if the active electrode is in direct connection with the source, and the interruption is made between the indifferent electrode and the source, the potential of the active electrode remains constant and excitation is made at an invariable potential. When, however, the interruption is made between the active electrode and the source excitation is made at a variable potential, and it is always stronger than in the first case.

H. W. P. Y.

2699. *Apparatus for Measuring the Electrical Resistance of the Human Tissues.* **H. Bordier.** (Archives de Él. Médicale, 11. pp. 544–547, Sept., 1903. Communication made to the Congrès d'Angers, Aug., 1903.)—In a circuit of a constant current at, say, 110 volts, is placed a wire of ferro-nickel having a resistance of exactly 50 ohms at ordinary temperatures, a 50-volt lamp, a rheostat, and an amperemeter. By means of the rheostat the current is given an intensity of 1 amp. exactly, so that the difference of potential between the two ends of the ferro-nickel wire amounts to 50 volts. A derived circuit is taken from one end of the resistant wire, on the one part, and, on the other, from a movable button which can be displaced along the length of this wire. In this circuit the subject to be tested is placed by means of electrodes. It also contains a milliamperemeter. As the two connections on the resistance wire are separated the difference of potential e between them is increased. If l equals this distance and L the total length of the wire, $e = \frac{50l}{L}$. If l be increased until the ammeter in the derived circuit $= 0{\cdot}001$ amp., then the resistance of this circuit $x = \frac{e}{0{\cdot}001} = \frac{50{,}000}{L} \times l$. The resistance of the circuit without the subject can be estimated by placing the two electrodes together with the same amount of pressure as that with which they are applied to the subject. H. W. P. Y.

2700. *Radiotherapy in Ozæna.* **A. Casassa.** (Revue Int. d'Électrothérapie, 18. pp. 247–252, Feb. and March, 1904. From Revue Internationale de Thérapie Physique.)—Several cases of ozæna were subjected to radiotherapy and their condition tested bacteriologically from time to time. The good results obtained lead the author to conclude that this is the best treatment for the disease and that it not only has a bactericidal action on the micro-organisms present, but also exerts a healing influence on the mucous membrane. The bacillus mucosus ozenæ of Lœvenberg was found to be invariably present in the mucus of untreated cases, and the author is of opinion that although this organism cannot as yet be accepted as the specific agent, yet it must have a more or less direct action in the evolution of ozæna since it is constantly present, is found in no other affection, and disappears only with the cure of the disease. H. W. P. Y.

2701. *Treatment of Neuralgias by the Salicylic Ion.* **S. Leduc.** (Archives d'Él. Médicale, 12. pp. 403–406, June 10, 1904.)—Treatment of neuralgia should be symptomatic and causal. Electrical treatment alone fulfils both conditions. It is analgesic as well as curative. A successful case of neuralgia of a branch of the ophthalmic nerve is quoted in the treatment of which the author employed 2 per cent. solution of sodium salicylate and a current of 20 milliamps. for half an hour at a time. The salicylic ion is well tolerated by the skin. It produces little reaction and no change in the normal sensibility but a marked amelioration of pain. H. W. P. Y.

2702. *Complementoids and the Combining Properties of Serum-Complements.* **R. Muir** and **C. H. Browning.** (Roy. Soc., Proc. 74. pp. 1–19, July 19, 1904.)—The investigations were carried out on ox's corpuscles with the immune-body from the rabbit, used along with rabbits' and guinea-pigs' complements and complementoids. The following conclusions were obtained: (1) The existence of complementoids in heated sera can be shown in ordinary test-tube experiments by their preventing the union of complement with anti-complement, and the union of complement with the combining molecules or receptors of the red corpuscles + immune body ($= R + IB$) after lysis. (2) The amount of complementoid derived from complement, as tested by the combining relationships, varies; in the case of the rabbit it is approximately equal to the original amount of complement; in the case of the guinea-pig it is considerably less than that amount.

(3) The combining affinity of complementoid, both for anti-complement and for R + IB molecules after lysis, is not much inferior to that of complement. (4) On the other hand, complementoid has a feeble affinity for R + IB molecules before lysis, *i.e.*, for intact red corpuscles treated with immune-body; of the complementoid added only a small quantity enters into combination; hence complementoid does not prevent lysis by complement. (5) When red corpuscles united with multiple doses of immune-body are lysed by a single dose of complement, the surplus R + IB molecules can be saturated with excess of complementoid, so that almost no complement can be subsequently taken up. This result is obtained also with rabbits' complementoid and guinea-pigs' complement, and with guinea-pigs' complementoid and rabbits' complement. H. W. P. Y

2703. *Localisation of Foreign Bodies in the Cranium.* **G. Contremoulins.** (Revue Scientif. 2. pp. 137–141, July 30, 1904).—The apparatus consists of a right-angled metal frame, one side of which carries the photographic plate, the other two supports for the Röntgen-ray tubes. Behind and above there is an arrangement on which the back of the head rests. In front there is a three-branched compass which can be adjusted so as to come in contact with the skin of the forehead or face. The points of the skin touched by the three branches of the compass are marked with Indian ink. The position of the compass is fixed by tightening the screws. After the radiogram has been taken in the usual way, the plate is replaced and threads are stretched from the two images on the plate to the Röntgen-ray tube supports, which are specially adapted for the purpose. To the framework which carries the compass one or more rods are then attached by means of a piece of metal at right angles, which allows the rod to be moved up and down. Each rod, therefore, stands out some distance away from the compass. At the other end of the rod is a ring through which a long needle slides. The point of the needle is then applied to the point of intersection of the two threads, and the exact position is noted by means of a scale marked on the needle. This part of the apparatus is then removed and sterilised. At the operation the points of the compass are again applied in pressing the same position on the face, and the most favourable position for trephining is determined by the direction of the needle or needles. When the skull has been opened the apparatus is again applied, and the precise position of the foreign body is defined by the graduated needle. Special forceps (closed) are then thrust in, and before reaching the depth thus ascertained they are opened and the foreign body is seized and extracted. H. W. P. Y.

2704. *Electrical Reaction of Nerves and Muscles which have been long Inactive.* **Guilloz.** (Archives d'Él. Médicale, 12. pp. 552–554, July 25, 1904.) —If the minimum intensity which will produce contraction of muscle be determined by gradually increasing the current from zero until excitation is obtained, and subsequently the current be diminished again, it is found that excitation can now be effected at an intensity slightly less than the first value. This is the case with all muscles, both healthy and otherwise, and both with continuous and interrupted currents. But, whilst with healthy muscles the difference between the two values is very slight, it becomes very marked with muscles which have been functionless for a prolonged period. The difference may then be as great as 20 or 30 per cent. The phenomenon has to do with the mechanical inactivity of the muscle, which needs a stronger current to provoke the first contraction than is subsequently necessary. H. W. P. Y.

REFERENCES.

2705. *Liquid Dielectrics under High-Frequency Oscillator Discharges.* **E. Marx.** (Ann. d. Physik, 12. 3. pp. 491–534, Sept., 1903. Leipziger Habilitationsschrift.)—Various liquid dielectrics are exposed in a branch circuit to oscillatory discharges of periods between 10^{-7} and 10^{-8} second to ascertain if the dielectric constant is a function of the frequency. Petroleum was tested with discharges of wave-lengths between 13·2 m. and 30·6 m.; benzole was tested with wave-lengths from 11 m. to 35·6 m.; and water with wave-lengths 11 m. to 17·8 m. In each case the result was negative, no dispersion of the dielectric constant of the order of 1 per cent. being detectible. E. H. B.

2706. *Volta and Dispersion of Negative Charges.* **A. Volta.** (Rivista Sci. Industriale, 35. pp. 109–114, Aug. 31–Sept. 15, 1903.)—In a paper on the behaviour of flame in electrostatic discharges, giving tabulated data, the author shows that the relative inefficiency of smoke as a conductor and the greater dispersibility of negative than positive charges were recorded by Volta in 1787 in MSS. now in the charge of the Reale Instituto Lombardo. A. D.

2707. *Electrons.* **G. Herglotz.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 6. pp. 357–382, 1903.)—A mathematical treatment of the motion of electrons. The fundamental equations are derived from the Hamiltonian principle. J. W. P.

2708. *Steady Flow of Electricity in Solid Conductors.* **B. O. Peirce.** (Annals of Mathematics, 5. 4. pp. 153–168, July, 1904.)—A mathematical discussion of some elementary theorems concerning the steady flow of electricity in massive conductors. E. H. B.

2709. *Electron Theory and Radio-activity.* **C. Schaefer.** (Zeitschr. Vereines Deutsch. Ing. 48. pp. 992–996, July 2, 1904.)—A compact *résumé* of the above subjects from 1896 to the present time. E. H. B.

2710. *Rate of Recombination of Ions in Gases.* **G. W. Walker.** (Phil. Mag. 8. pp. 206–211, Aug., 1904.) **R. K. McClung.** (Phil. Mag. 8. pp. 211–215, Aug., 1904.)—Walker criticises the experiments and results of R. K. McClung [see Abstracts Nos. 609 and 1124 (1904)]. McClung replies to these criticisms and explains his own results. J. J. S.

2711. *Recorder for Strutt's Radium Electroscope.* **F. H. Glew.** (Nature, 70. pp. 246–247, July 14, 1904.)—The periodical discharge of this electroscope may be made self-recording—to ring a bell or make a dot on a Morse tape as desired. A coherer is placed in the outside circuit, and is actuated when the leaf strikes the knob. P. E. S.

2712. *Electric Dispersion on the Eiffel Tower during Thunderstorms.* **A. B. Chauveau.** (Comptes Rendus, 139. pp. 277–278, July 25, and pp. 400–401, Aug. 8, 1904.)—Though the dispersion varies much on the Eiffel Tower, the negative dispersion always predominates. Just before and during the thunderstorm of July 24, however, the positive dispersion increased to 20·5, while the negative was only 6·7. The storm of Aug. 8 came on very suddenly about 6.30. The afternoon had been serene, and the prevalence of the negative discharge increased until the storm broke out. The positive discharge then became extraordinarily rapid, as if under radioactive influence, while the rate of negative dispersion remained normal. The change may be due to the violent wind bringing up dust clouds, and the heavy rains. H. B.

2713. *A Discontinuous Mercury Vapour Lamp.* **L. Kallir.** (Zeitschr. Elektrotechn., Wien, 21. pp. 501–503, Aug. 30, 1903.)—The author describes some experiments with a mercury vapour lamp, which he carried out in 1900, showing that the lamp can be used as an interrupter. L. H. W.

2714. *Graphical Solution of Network Problems.* **E. Aoyagi.** (Coll. Sci. and Engin., Mem. Kyōto, 1. 1. pp. 40–54, 1903.)—The author develops a graphical method of representing the drops of potential and determining the distribution of currents in a continuous-current network, and then extends the method to alternating currents. This latter part of the investigation leads him to a laboratory method of obtaining leading currents without the use of condensers or synchronous motors. A. H.

2715. *Critical Pressure for the Luminescence of a Gas.* **A. de Hemptinne.** (Bull. Acad. Roy. Belg. No. 8. pp. 851–863, 1903.)—Measurements were made of the critical pressure at which a gas is most easily made luminescent and has its greatest conductivity, a Tesla coil being used, and in some cases a strong magnetic field applied. The author concludes that, in general, the excitation of luminescence depends on the movement of the gas particles, and that it is not so much the distance separating the electrodes as the volume of the gas bounded by the electrodes which is the determining factor in the production of the luminescence. L. H. W.

2716. *Potential Difference between the Terminals of a Vacuum Tube.* **W. A. D. Rudge.** (Cambridge Phil. Soc., Proc. 12. pp. 155–162, Oct., 1903.)—Discs of metal pierced with holes of different sizes are placed at various positions in a cylindrical discharge tube, and the potentials measured and compared with those of a standard tube at the same gas pressure. It is found that the presence of a perforated disc increases the resistance of the tube. Between gas pressures of 1–5 mm. the increase is inversely proportional to the area of the aperture of the disc. The maximum effect is produced at a short distance from the kathode; it also depends upon the nature of the metal of which the disc is composed, the lower the atomic weight the greater the increase of resistance. R. S. W.

2717. *Rate of Recombination of Gaseous Ions.* **O. W. Richardson.** (Cambridge Phil. Soc., Proc. 12. pp. 144–152, Oct., 1903.)—A mathematical paper. The rate of recombination is calculated by a method originally given by Sutherland. In order that the results shall be comparable with experiment it is necessary to know more about the size of the ions. Various lines of work have shown that, at ordinary pressures and temperatures, the gaseous ions are complex instead of being merely corpuscles or atoms from which a corpuscle has been expelled. R. S. W.

2718. *Sparking Distance and Potential.* **W. Voege.** (Ann. d. Physik, 14. 3. pp. 556–568, July, 1904. Physikal. Staatslaboratorium, Hamburg, April, 1904.)—From experiments on this subject it is concluded that the potentials necessary to spark across large distances in air are nearly proportional to those distances. E. H. B.

2719. *Rectifying Effects in Conducting Gases.* **P. G. Nutting.** (Phys. Rev. 19. pp. 1–7, July, 1904.)—The tubes are run from a transformer. In series with a tube is a direct-current milliamperemeter and also an alternating current instrument. The latter gives the total current, the former the rectified current. The effect of altering the material, size, and shape of the electrodes, the pressure, and the temperature are investigated. R. S. W.

2720. *Electric Spark.* **J. Semenov.** (Annal. Chim. Phys. 2. pp. 345–432, July, 1904.)—A large part of this paper is historical and deals with facts which are now matters of common knowledge. The author thinks that the ionic theory is not sufficient to explain the mechanism of the spark, and rejects in addition, as not established, the delay in the electric discharge discovered by Warburg. R. S. W.

2721. *Kathode Disintegration.* **L. Holborn** and **L. W. Austin.** (Phil. Mag. 8. pp. 145–157, Aug., 1904.)—Translation of paper dealt with in Abstract No. 1492 (1904).

2722. *Measurement of Inductances and Capacities by Bridge Methods.* **G. Brion.** (Elektrotechn. Zeitschr. 24. pp. 623–624, Aug. 6, 1903.)—The author explains certain practical details connected with such measurements, by means of which the work of adjustment is rendered more systematic, thereby leading to a saving of time. A. H.

2723. *Construction of Electrical Standards.* (Electrician, 51. pp. 971–975, Oct. 2, 1903. Report presented at the Annual Meeting of the British Association at Southport, 1903.)—Contains a detailed discussion of various standards of resistance, of comparisons between them, and of changes that have taken place in them during recent years. These are recorded in tables at the end of the paper. Constancy in the values of condensers and in the indications of platinum thermometers is next considered, from which it appears that the latter, if properly constructed, may be used for prolonged periods at temperatures up to 1,000 C. without fear of serious changes. Tables showing the life-history of various platinum thermometers are given in an appendix. [See also Abstract No. 2009 (1904).] J. D. C.

2724. *Electrocapillarity and Drop-Electrodes.* **F. Krüger.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 1. pp. 33–48, April 30, 1904.)—A critical summary and discussion of theories—Lippmann, Helmholtz, Planck, Warburg, Ostwald and Paschen, Nernst, Gouy, Rothmund, S. W. J. Smith, Kučera, G. Meyer, and others—and a theory indicated which combines Lippmann, Helmholtz, and Warburg, modified by Nernst. A. D.

2725. *Aperiodic Electric Currents.* **H. Tallqvist.** (Ann d. Physik, 14. 3. pp. 602–608, July, 1904.)—The differential equations for the current in a single circuit, in parallel circuits, one or both having self-induction, and for two currents having mutual induction are obtained, and the solutions given. S. G. S.

2726. *Measurement of Inductances and Hysteresis Losses with Alternating Currents.* **F. Dolezalek.** (Zeitschr. Instrumentenk. 23. pp. 240–248, Aug., 1903. Électricien, 28. pp. 49–55, July 23, 1904.)—Describes with theory, sections, and perspective views a compact testing set for the determination of inductances and energy losses by hysteresis and eddy currents. [See Abstract No. 322 (1899).] E. H. B.

2727. *Effects of Form and Winding on Resonance Phenomena.* **C. A. Wright.** (Röntgen Soc., Journ. 1. pp. 9–15; Discussion, p. 15, July, 1904.)—An account of experiments undertaken to determine the nodal points in coils of various forms when traversed by oscillatory currents. The coils used had the following forms: Cylindrical, conical, flat, plano-convex, plano-concave, spherical, lenticular; and the results obtained are shown in three tables. E. H. B.

2728. *Obtaining Resonance with Tesla Transformers.* **H. Mosler.** (Elektrotechn. Zeitschr. 25. p. 857, Sept. 29, 1904.)—The author describes a convenient method of bringing the secondary of the Tesla transformer into resonance with the closed oscillating circuit. A fixed, not too large, capacity is connected in parallel to the coil terminals and a variable inductance in the form of 20 turns of 2-mm. diam. wire wound on a varnished wood drum about 30 cm. in diam., is placed in the oscillating circuit in series with the transformer primary, contact being made by a slip-ring and a roller running on the wire on the drum. Starting with all the inductance in, the drum is rotated, taking out inductance until an intense brush appears at the secondary terminals. The experiments of Seibt can be repeated with this device by merely connecting one terminal of the secondary direct to the oscillating circuit instead of inductively. The dimensions of L and C must, of course, be suitably chosen. L. H. W.

2729. *High-Pressure Direct-Current from Alternating or Direct-Current Source.* **F. J. Koch.** (Ann. d. Physik, 14. 3. pp. 547–555, July, 1904. Engineering, 78. p. 379, Sept. 16, 1904. Abstract.)—Describes with elaborate diagrams a method for obtaining high-potential direct-currents for spark discharges and other purposes from alternating- or direct-current sources. Reproductions of photographs of the sparks thus obtained and other figures are given. E. H. B.

2730. *Is the Susceptibility of Iron and Manganese Salt Solutions Dependent upon Strength of Field?* **A. Heydweiller.** (Ann. d. Physik, 12. 3. pp. 608–621, Sept., 1903. Physikal. Inst. der. Univ., Münster, June, 1903.)—Owing to the contradictory results obtained by Silow, and by Gerosa and Finzi, the author got O. Wylach to repeat Silow's experiments, and as a result finds that the great changes noticed by Silow do not exist, the susceptibility, on the contrary, being constant, to within 10 per cent. at most, within the range of field strength 0·1 to 1·2 c.g.s. units. Additional experiments were made to determine the effect over greater range of field strength than ever tried before (0·1 to 40,000 c.g.s.). It was found that alteration of susceptibility can take place over such a range, very slight in the case of ferric chloride, somewhat larger with ferrous and manganous chlorides, and reaching 30 to 40 per cent. in the case of the sulphates. The formation of complexes in these solutions is, therefore, considered likely. L. H. W.

2731. *Magnetisation by Alternating Currents of High Frequency.* **O. M. Corbino.** (Atti dell' Assoc. Elettr. Ital. 7. pp. 606–610, Sept.-Oct., 1903.)—In order to observe whether the hysteresis effect increases or diminishes at high frequencies, the author makes use of a Braun tube and photographs the magnetisation curves produced at frequencies ranging from 4 to 20,000. He finds that the area of the curve for a cycle of magnetisation increases rapidly at first, but for further rise in the frequency the area increases very slowly. Photographs of the curves are reproduced in the paper. [See also Abstracts Nos. 129 and 322 (1899).] S. G. S.

2732. *Chains of Force.* **M. Hartog.** (Comptes Rendus, 138. pp. 1523–1525, June 13, 1904.)—Distinction drawn between ideal lines of force and the actual "chains of force," or lines which iron filings or magnetic oxide assume upon prolonged agitation, concentrating the lines of force and shortening them. Study of these chains of force in viscous media; and biological analogies. A. D.

2733. *New Magnetometric Method.* **H. T. Simon** and **E. Madelung.** (Phys. Zeitschr. 5. pp. 410–413, July 15, 1904. Physik. Institut, Göttingen.)—To measure magnetic moments, and hence susceptibilities, the effect of a bar magnet at distance R from a needle is balanced by means of a circular current of radius R. All the specimens employed are ellipsoids of uniform size: major axis, 6 cm.; minor axis, 0·3 cm. The demagnetising effect can thus be calculated, and this enables the moment of the bar to be expressed in the terms: current strength × constant. A movable coil also is employed instead of a steel needle. Observations and hysteresis curves for a steel specimen are given. G. E. A.

2734. *Cause of the Earth's Magnetism.* **W. Sutherland.** (Terrestrial Magnetism, 8. pp. 49–52, June, 1903.)—The author gives a formula for the magnetic potential round parallels of latitude of a revolving sphere which is charged with electricity. If the negative and positive charges are spread over concentric spheres whose radii differ by the diam. of a single molecule, the earth's magnetic field could be accounted for. The same would result if there were minute differences between the opposite magnetic fields generated by the opposite electricities associated with matter. Such a theory of stellar magnetism presumes, however, a demonstration of the difference in the attraction of matter for the two sorts of electricity and the determination of the law of this attraction. H. B.

2735. *Influence of Field on Torsion.* **A. Gray** and **A. Wood.** (Roy. Soc., Proc. 73. pp. 286–291, May 7, 1904.)—A wire is hung with a heavy or light load as required. A longitudinal magnetic field of varying strength can be applied. The experiment consists in observing how field influences the damping of the torsional oscillations. The wire is tested when annealed and unannealed, and when drawn out to various diameters. P. E. S.

2736. *Magnetic Survey of Japan Reduced to* 1895.0. **A. Tanakadate.** (Mathematical and Physical Soc., Tokyo, 2. 12. pp. 149–150, May, 1904. Abstract.)—The survey was made by sixteen observers during the summers 1890–1896; the full report has appeared in the journal of the College of Science, Imperial University, Tokyo, vol. xiv. Empirical formulæ are given for declination, dip, and horizontal intensity. Vertical currents are determined both by taking line integrals round the country and by surface integrals; the real existence of these currents is doubted. From the differences between observed and calculated values maps of magnetic ridge and valley lines are drawn. H. B.

2737. *Magnetic Exploration of the Padirac Gorge.* **E. Mathias.** (Comptes Rendus, 139. pp. 274–276, July 25, 1904.)—On the suggestion of E. A. Martel, who has explored the subterranean river of Padirac, the author has determined the horizontal component and inclination on the banks of the subterranean Lac des Grand Jours; both elements are found to be slightly higher, by 0·001 of their value, at the depth of 100 m. than on the surface. The measurements were made in May and August on magnetically calm days; underground unsteady values were observed, owing partly to the illumination by triphase currents of 50 periods; one determination was effected while supply was stopped at the generating station. Instruments of Brünner and of Chasselon were used. H. B.

2738. *Diurnal Variation of the Declination in China.* **J. de Moidrey.** (Terrestrial Magnetism, 9. pp. 15–17, March, 1904.)—Shinjo, Otani, and Yamakawa having in 1903 determined the magnetic elements at several places in China [see Abstract No. 379 (1904)] in taking, for instance, 21 declination observations within 33 hours, the author compares their results with the records of his apparatus at Zi-ka-wei, taking the same days and local times as abscissæ. The curves for Hong-kong and Cha-che agree very well with those of Zi-ka-wei, the amplitudes at Hong-kong being smaller in the ratio 4/7. The agreement for Hankow is less striking, but on the whole the declination records for Zi-ka-wei may be accepted for the Yang-tse River up to Cha-che. H. B.

2739. *Electromotive Phenomena in Mammalian Non-medullated Nerve.* **N. H. Alcock.** (Roy. Soc., Proc. 73. pp. 166–180, March 23, 1904. Physiological Lab. University of London.)—[See Abstract No. 1257 (1903).]

2740. *Electric Steriliser for Surgical Instruments.* **L. de Kermond.** (Électricien, 26. pp. 118–119, Aug. 22, 1903.)—The instruments are sterilised in the box which is used to carry the instruments. The air in the box is heated by a *plaque chauffante*, and by means of a regulating apparatus the temperature is maintained between 170° and 180°. The method was suggested by Diart. H. W. P. Y.

2741. *Diagnosis of Biliary Calculi by Radiography.* **Mauclaire** and **Infroit.** (Comptes Rendus, 137. pp. 482–483, Sept. 21, 1903.)—The authors give details of a successful case of radiographic diagnosis of biliary calculi. The radiography of such calculi had hitherto been unsuccessful, owing, the authors consider, to too penetrating a tube being used, the chemical composition of the calculi being so very variable; they often are nearly transparent. L. H. W.

CHEMICAL PHYSICS AND ELECTRO-CHEMISTRY.

2742. *Separation of Didymium into its Elements.* **C. A. v. Welsbach.** (Akad. Wiss. Wien, Sitz. Ber. 112. 2a. pp. 1037–1055, July, 1903.)—In this interesting paper the author gives a further account of his work on the fractional separation of didymium into the two elements praseodymium and neodymium. The method chiefly consisted in the fractional crystallisation of the double ammonium nitrates. The final results prove conclusively that the two substances, praseodymium and neodymium, are true elements with no intermediate element. A lengthy description of the separation is given in the paper. The spark spectra of these elements is also dealt with, but it is stated that these are poor tests of the purity; no measurements are given, these being reserved for a later paper. The absorption spectra are also discussed, a plate of these being given in the paper. Finally, the atomic weights have been redetermined for the pure substances and were found to be: Praseodymium 140·57, and neodymium 144·54. [See also Abstract No. 2803 (1904).] E. C. C. B.

2743. *Microscopical Method of Determining Molecular Weights.* **G. Barger.** (Chem. Soc., Journ. 85. and 86. pp. 286–324, Feb., 1904.)—The method consists in the introduction into a capillary tube, 6–8 cm. long and 1·5 mm. bore, of alternate drops of solutions of the substance under examination and of a standard substance of known molecular weight, the same solvent being used for both solutions, which are of definite strengths. The tube is fastened to a microscope slide and the drops measured by means of a microscope, in the eyepiece of which is a graduated scale. It is then placed in a glass Petri dish, in which is sufficient water to cover the tube and thus keep the drops always at the same temperature. After some time the tube is again examined under the microscope, it being noted which drops have increased in size, and by regulating the strength of the standard solution a point is reached when the drops of both remain of approximately the same size. When this is so, the solutions are considered to contain the same number of molecules, since their vapour pressures are equal. A large number of molecular weights have been determined by the method with good results, and its use is suggested in the study of the ionisation of salts in mixtures of an ionising with a non-ionising solvent, and also of association in mixtures of associative and non-associative solvents. Preliminary experiments on the latter subject seem to indicate that a small proportion of alcohol added to a mixture of two substances prevents association. Attempts to calculate molecular weights directly from the change in size of the drops proved unsuccessful. W. H. Si.

2744. *Decomposition of some Acid Sulphates by Mechanical Deformation.* **W. Spring.** (Bull. Acad. Roy. Belg. pp. 290–309, 1904. Chem. Centralblatt, 1. pp. 1630–1631, 1904.)—It was found that when some acid sulphates, both anhydrous and containing water of crystallisation, are subjected to very high pressure, with deformation, in a steel cylinder provided with a small hole at the bottom, an alteration in composition of the salt took place. With lithium hydrogen sulphate (anhydrous) a portion richer in acid and of composition approximately $9LiHSO_4 . 2H_2SO_4$ flowed through the hole, while the salt left was almost of the composition of normal sulphate. With $LiHSO_4 . H_2O$ a similar effect was observed. Sodium anhydrosulphate gave no such action, but the different hydrates of this at somewhat higher temperatures separated out large amounts of water of crystallisation and sulphuric acid. Acid sulphates of K, Rb, and Cæ showed no alteration. With mixtures of the anhydrosulphate with basic oxides of lead, copper, mercury, and silver in a closed cylinder no reaction took place, but when the hole was open, introducing the element of deformation, chemical reaction took place until the acid in the acid salt was neutralised. By rubbing the two compounds together a similar action can be produced—with copper oxide a white compound, $CuSO_4 . Na_2SO_4 . H_2O$. L. H. W.

2745. *Estimation of Potassium.* **N. Tarugi.** (Gazzetta Chim. Ital. 34. 1. pp. 324–341, 1904.)—The principle of this method is as follows: When a suitably concentrated solution of sodium persulphate is added to a solution of potassium sulphate, the potassium persulphate formed mostly separates in a solid, crystalline condition, only a small proportion of it remaining in solution. By titrating the sodium persulphate solution with standard sodium hydroxide solution, both by itself and after mixing with the potassium salt and making a suitable correction for the potassium persulphate remaining in the solution, the amount of potassium salt in the original liquid can be determined. The author has measured the solubility of potassium persulphate in water and in various salt solutions, which all give the same values, so that the allowance for solubility becomes greatly simplified. The solubility curve consists of four straight lines represented by the four equations: $y = 0{\cdot}108x + 1{\cdot}62$ (0° to 9°); $y = 0{\cdot}008x + 2{\cdot}52$ (9° to 10°); $y = 0{\cdot}108x + 1{\cdot}52$ (10° to 15°); and $y = 0{\cdot}270x - 0{\cdot}91$ (15° to 40°), where y is the solubility and x the temperature in ° C. From these values, the equations by which the corrections to be applied to the amount of K_2O found by this method are readily found, and are: $y = 0{\cdot}0376x + 0{\cdot}564$ (0° to 9°); $y = 0{\cdot}00278x + 0{\cdot}8773$ (9° to 10°); $y = 0{\cdot}0376x + 0{\cdot}529$ (10° to 15°); and $y = 0{\cdot}094x - 0{\cdot}3164$ (15° to 40°). Details of the analytical method are then given. T. H. P.

2746. *Vapour Density of Hydrazine Hydrate.* **A. Scott.** (Chem. Soc. Journ. 85. and 86. pp. 913–918, June, 1904.)—Determinations of the vapour density of hydrazine hydrate at various temperatures and with different forms of apparatus show that at 100° in a vacuum 58 per cent. is dissociated into hydrazine and water, the dissociation being complete at 140°. Under atmospheric pressure hydrazine decomposes at 183° into nitrogen and ammonia, while at 460–480° the ammonia itself begins to decompose. The oxygen of the air attacks hydrazine at 183°, especially under slightly increased pressure, but under similar pressures, in nitrogen, hydrazine seems to be stable in the presence of water, though not so at 300°. The nature of the surfaces to which the hydrazine vapour is exposed and its dilution with other gases exert a considerable influence on the initial temperature and rate of decomposition.
W. H. Si.

2747. *Vicosity of Liquid Mixtures.* **A. E. Dunstan.** (Chem. Soc., Journ. 85. and 86. pp. 817–827, June, 1904.)—The author has studied the viscosities of liquid mixtures, using a U-tube viscometer, one limb of which is capillary (15 × 0·05 cm.), terminating at its upper extremity with a 5-c.cm. cylindrical bulb, while at the base of the other limb is a receiving bulb. Mixtures of water with methyl alcohol, ethyl alcohol, and benzene are found to give well-defined maximum points, those of ethyl alcohol with benzene and benzaldehyde minimum points. Results approximating to the normal are given by mixtures of ethyl alcohol with carbon bisulphide and acetone, and ethyl acetate with benzene, though in all three cases a considerable amount of sagging of the curve plotted with absolute viscosities as ordinates, and percentage composition as abscissæ, is shown to occur. The points where the deviation from the normal is greatest are in all cases at or near those of definite molecular composition, but these vary with change of temperature, and would probable vanish at a sufficiently high temperature. The minimum points of viscosity are considered to indicate some change of molecular aggregation due to association or dissociation. Compounds containing hydroxyl usually have a higher viscosity than monomolecular liquids, which would explain the rapid rise of viscosity in the ethyl alcohol-water mixture.

W. H. St.

2748. *Velocity of Absorption of Gases by Solids.* **A. Hantzsch.** (Zeitschr. Phys. Chem. 48. pp. 289–329, June 7, 1904.)—This paper is a study of the velocity of absorption of ammonia gas by solid acids, and of hydrochloric acid gas by solid amines and basic substances. The course of the reaction is followed by measuring the change in volume of the gas kept at constant total pressure. If the latter be pure ammonia, or a mixture of air and ammonia, containing very much more ammonia than is requisite to just neutralise the acid, the reaction is found to follow the law, velocity $\propto$ (reacting mass of solid acid), the latter being taken as proportional to the volume of ammonia which it can still absorb. If, however, the air-diluted ammonia be used in equivalent amount, the law is velocity $\propto$ (reacting mass of acid) $\times$ (concentration of ammonia), as in this case the partial pressure of the ammonia diminishes. Similar remarks apply to the absorption of hydrochloric acid gas by solid bases. If the acid or base be comparatively strong, disturbances arise when undiluted ammonia (or HCl) is used, due to surface-melting, &c., caused by the great local evolution of heat. The phenomena studied in this paper belong to the class of reactions in heterogeneous media. The equations which govern them are due to the laws of diffusion, rather than to those of chemical kinetics. The interesting point is that in the case of true acids and bases *constant* velocity-coefficients are obtained under suitable conditions. In the case of pseudo-acids and pseudo-bases, the author states that constant velocity-coefficients are not obtained, and proposes on this to found a new method of diagnosis. The data bearing on this point he reserves for a purely chemical journal.

F. G. D.

2749. *Atomic Weight of Nitrogen from the Volumetric Analysis of Nitrogen Monoxide.* **A. Jaquerod** and **St. Bogdan.** (Comptes Rendus, 139. pp. 49–51, July 4, 1904.)—The method used by the authors to determine the atomic weight of nitrogen consists in decomposing nitrogen monoxide in a glass bulb of constant volume by means of an iron wire spiral heated to redness by an electric current, and measuring the increase of pressure at 0° by an accurate manometer. From this increase, together with the initial pressure and the densities of nitrogen monoxide and nitrogen, the atomic weight of nitrogen can be calculated from the value of the ratio $N_2 : N_2O$. Taking for the densities of nitrogen monoxide and nitrogen the values 1·9779 and 1·2504 given by Rayleigh and Leduc, the atomic weight of nitrogen is found to be 14·019 ($O = 16$).

T. H. P.

2750. *Union of Hydrogen with Sulphur, Selenium, and Tellurium.* **F. Jones.** (Manchester Lit. and Phil. Soc., Mem. 48. 16. pp. 1–5, July, 1904.)—The author proves the direct combination of hydrogen with sulphur by heating a piece of pure sulphur to its boiling-point in the shorter, sealed arm of a bent glass tube filled with hydrogen, and the other end of which dips into a solution of soda, when the soda rises steadily in the tube, indicating the formation of some sulphuretted hydrogen which is absorbed. Combination is also shown by the fact that, when a piece of sulphur is sealed up in a tube with hydrogen and heated in a bath of boiling sulphur, the contents are entirely soluble in soda solution. The reaction takes place only at temperatures very near the boiling-point of sulphur, no union being observed at its melting-point. The bent tube method has also been employed to effect the combination of hydrogen with selenium and tellurium, with both of which hydrogen unites much more readily than with sulphur. W. H. Si.

2751. *Action of the Salts of the Alkaline Earth Metals on the Living Substance.* **N. C. Paulesco.** (Comptes Rendus, 139. pp. 158–160, July 11, 1904.)—The author has studied the action of the salts of the alkaline earth metals on brewers' yeast, for the purpose of determining the relation between the molecular weight of the salts and the quantities of the salts required to produce a given effect (arrest of evolution of carbon dioxide) under the same conditions, with yeast. As a result he finds that the minimum amounts of the salts required are nearly equal to the molecular weights of the salts divided by 1·10, or that the limiting amounts are proportional to the molecular weights. In the case of the magnesium salts, the results obtained do not agree with those obtained with salts of barium, calcium, strontium. One gm.-mol. of the salt of an alkaline earth metal produces an effect equal to that produced by 2 gm.-mols. of an alkaline metal. A. F.

2752. *Vapour Densities of Sulphur Dioxide and Oxygen.* **A. Jaquerod** and **A. Pintza.** (Comptes Rendus, 139. pp. 129–131, July 11, 1904.)—Employing the method of Morley, which consists in weighing the gas-generating apparatus before and after filling with the gas a large globe of known volume, to which is attached a manometer, the authors find 1 litre of oxygen at 0° and 760 mm. pressure to weigh 1·4292 gm., and 1 litre of sulphur dioxide 2·92664 gm. Determinations of the weight of 1 litre of sulphur dioxide at 0° and pressures of 570 mm. and 380 mm. give 2·18172 and 1·44572 gm. respectively, and from these the compressibility of the gas may be calculated, and also, by the method of limiting densities, the atomic weight of sulphur, which latter is found to be 32·01. The oxygen was prepared by heating potassium permanganate, and for sulphur dioxide the generating apparatus merely consisted of a small, moderately strong glass cylinder half filled with the liquefied gas. W. H. Si.

2753. *Determination of Vapour Density by Increase of Pressure and its Limits of Accuracy.* **W. Haupt.** (Zeitschr. Phys. Chem. 48. pp. 713–724, July 12, 1904. Math.-physik. Laboratorium der Univ., Königsberg, March, 1904.)—The method of measuring the vapour density from the increase of pressure which a given quantity of vapour produces in a known volume at a certain temperature has been but little employed, and its limit of accuracy has been variously given (from 1 to 4 per cent.). The author deduces the exact formula to be used in this method, and shows that neglect of the fact that the gas in the connecting tube between the flask and manometer may have a different temperature and composition than the main quantity, may lead to an error of 1 per cent; the ordinary errors of reading off and weighing may amount to 0·3 per cent. The results of measurements of the vapour densities of ether, benzene, toluene, and chloroform at 100° are given, the mean error being 0·2 per cent. This method has narrower limits of error than the methods of Dumas, Hofmann, and V. Meyer. T. H. P.

2754. *Contributions to the Determination of the Relative Viscosity of Liquids.* **K. Beck.** (Zeitschr. Phys. Chem. 48. pp. 641–681, July 12, 1904. Communication from the Institut von E. Beckmann, Laboratorium f. angew. Chemie, Leipzig.)—In the first part of this paper the author communicates a few results of an investigation of the viscosity of living blood, in which he found that the viscosity of healthy blood varies only slightly. An apparatus is also described which allows of the viscosity of opaque substances being determined, but the accuracy of this apparatus has not yet been sufficiently tested. In the second part of the paper the author studies the value of the constant of viscosity as a means of detecting differences in constitution, and has measured the viscosity of a number of substances and of mixtures of these. The substances chosen were dibenzyl, stilbene, azobenzene, benzylaniline, and benzalaniline; and as these have a high boiling-point, the author chose the m.p. as the temperature at which the experiments were carried out. The following values for the molecular viscosity, referred to benzene, were found:—

Substance.	Melting-point.	Temp. of Experiment.	Viscosity Referred to Benzene at 5°.	Molec. Viscosity.
Dibenzyl	52°	53·0°	2·5214	452·93
Azobenzene	68	69·0	2·5078	419·15
Benzalaniline ...	49	50·0	2·5084	422·34
Stilbene	124	125·0	2·5103	465·61
Benzylaniline ...	32	33·0	2·5106	430·02

The above substances are isomorphous, and as they have nearly the same viscosity, the values of the molecular viscosity are proportional to the molecular volume. Great differences are found on comparing non-isomorphous substances: *e.g.*, dibenzyl, viscosity = 2·5214; hydrazobenzene, 2·9184. The author has also measured the viscosity of homogeneous mixtures of the above substances, at the temperatures of the melting-points, which he has also determined. When the melting-point of the mixture agrees with that calculated according to the mixture formula, the viscosity is also a linear function of the composition; but when that is not the case, a minimum of the melting-point curve corresponds with a maximum of the viscosity curve. The author also sought, by measurements of viscosity, to determine whether racemates exist as such in the liquid state. He finds that mixed crystals break up into the optical antipodes and that is the case also with the racemates, racemic acid, and dimethyl diacetyl tartrate. His measurements in the case of the oximes of benzaldehyde and anisaldehyde are in agreement with the view that the α-oximes occur in two monotropic forms; and the monotropic modifications of iodine monochloride in the fused state have, under comparable conditions, identical viscosities. A. F.

2755. *Exact Molecular Weight Determinations from the Vapour Density.* **M. Reinganum.** (Zeitschr. Phys. Chem. 48. pp. 697–712, July 12, 1904. Physik. Inst. der Univ., Münster, March, 1904.)—The author discusses the results of Ramsay and Steele's [see Abstract No. 889 (1904)] measurements of the vapour density of various organic compounds, and those of Young [see Abstract No. 1689 (1899)] for isopentane. Assuming that, with dilute gases, forces of molecular attraction do not arise in the interior of the gas, van der Waals' equation may be modified to $p(V + B) = RT/M$, where B is a constant and M the molecular weight. The gas constant R is taken as 62,428 (volume in c.cm. and pressure in mm. of mercury). R/M should theoretically have the value 865·9, the atomic weight of oxygen being 16. Young's data for isopentane give 864·4. Not taking into account the numbers obtained for the lowest pressures and taking the absolute zero of temperature as − 278°, the data obtained by Ramsay and Steele give concordant values for R/M. The author concludes that no importance should be placed on the differences indicated by these authors between theory and experiment with reference to the molecular weights. Taking the atomic weight of carbon as 12, Ramsay and Steele's measurements on toluene, benzene, hexane, normal octane, and diisobutyl give that of hydrogen as 1·0070. Using Hofman's vapour density method at 100° and various pressures for benzene and toluene, the author obtains almost the same values for pV/MT as those given by Ramsay and Steele. The use of two or more different pressures gives a means for obtaining much more accurate measurements of molecular weight than are possible by the ordinary methods. It is not out of the question to determine atomic weights by the method and formula given by the author. T. H. P.

2756. *Internal Friction of Solutions.* **G. Rudorf.** (Zeitschr. Elektrochem. 10. pp. 473–474, July 15, 1904.)—It has been found by Fawsitt [see Abstract No. 1829 (1904)] that the values obtained by the author for the internal friction of solutions of urea are incorrect [see Abstract No. 364 (1904)], the apparatus used, which consists of a spiral capillary tube, causing systematic errors. Fawsitt's numbers show that in most cases the results are well expressed by the simple linear equation: $\eta = 1 + an$, where n is the normality. If the percentage difference between the observed and calculated friction is proportional to the normality, the substance polymerises in solution, whilst if it is proportional to n^2, the substance forms complex compounds with the solvent. The latter is the case with dimethylurea, which was studied by Fawsitt (*loc. cit.*). From his own and Fawsitt's numbers, the author shows that the friction of a solution of several substances is equal to the products of the values for the separate substances. T. H. P.

2757. *Atomic Weight of Tungsten.* **E. F. Smith** and **F. F. Exner.** (Chem. News, 90. pp. 37–39, July 22; 49–52, July 29; and pp. 66–68, Aug. 5, 1904. From Proceedings of the American Philosophical Society, 43. No. 176.)—After reviewing previous work on the atomic weight of tungsten, the authors describe their own experiments and results. By converting the hexachloride into oxide, they obtain the value 183·98–184·04, and, by oxidising the metal to trioxide, the value 184·065. The most probable atomic weight of tungsten is hence 184·05. T. H. P.

2758. *Surface-tension and Molecular Weight of Nitrous Oxide.* **L. Grunmach.** (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 40. pp. 1198–1202, July 28, 1904.)—In previous communications to the Berlin Academy [see Abstracts Nos. 17 and 2070 (1901) and 697 (1903)] it has been shown that the capillary wave method can be applied to the estimation of the surface-tension and molecular weights of condensed gases. The present work relates to liquid nitrous oxide. It was obtained from the English firm of Ash and Sons in steel bombs. From the bomb it was led through a sulphuric acid drying vessel and then into a condensation glass surrounded by wadding. The cooling liquid was petroleum ether reduced by liquid air to − 93° to − 95° C. The waves on the liquid were produced by a standardised tuning-fork, and the temperature by a standardised pentane thermometer which gave the boiling-point of the liquid nitrous oxide as − 89°·4 at a pressure of 741·1 mm. At this temperature the density of the liquid (σ) is 1·2257. The mean value of the surface-tension obtained was 26·328 dyne-cm. Calling this a and inserting its value in the formula—

$$M = \sigma\sqrt{\left(\frac{2{\cdot}27(\theta - t)}{a}\right)^3}$$

the molecular weight M is obtained. The critical temperature θ lies between 35°·4 and 36°·4 C., according to different authorities. The observed temperature of the liquid is denoted by t. The final result for the molecular weight is 43·52, which, considering the difficulty of obtaining some of the data, is a close estimation to the value 44·08 deduced from the gaseous N_2O.

W. W. H. G.

2759. *Revision of the Atomic Weight of Beryllium.* **C. L. Parsons.** (Zeitschr. Anorg. Chem. 40. 3. pp. 400–422, July 30, 1904. Translation. Chem. News, 90. pp. 61–64, Aug. 5, 1904. From the Journal of American Chemical Society.)—All previous determinations of the atomic weight of beryllium have been made on the hydrated sulphate, $BeSO_4, 4H_2O$, with the exception of one made on ammonium beryllium oxalate, $Be(NH_4)_2(C_2O_4)_2$. The author uses two anhydrous compounds, the acetonylacetate and the basic acetate. Seven analyses of the first of these give the value 9·113 ± 0·0059 (O = 16, H = 1·008, C = 12·01) and 9 of the basic acetate, the value of 9·113 ± 0·0033. The mean of this is 9·113 ± 0·0043. T. H. P.

2760. *Compounds Containing an Asymmetric Nitrogen and an Asymmetric Carbon Atom.* **H. O. Jones.** (Cambridge Phil. Soc., Proc. 12. pp. 466–468, Aug. 19, 1904.)—When a tertiary amine, in which one of the groups contains an asymmetric carbon atom, combines with an alkyl iodide, unequal quantities of two isomerides might be expected, and this is found to be the case when methyl *l*-amyl-aniline is combined with allyl iodide or benzyl iodide, thus establishing a further analogy between asymmetric nitrogen and carbon atoms. In the first case the two isomers may be separated by crystallisation from alcohol, but in the latter it is necessary to prepare the *d*- and *l*-camphor sulphonates and recrystallise from ethyl acetate. W. H. St.

2761. *Polymerisation of Inorganic Substances in the Liquid and Solid States.* **G. G. Longinescu.** (Annales Scientifiques de l'Univ. de Jassy, 2. pp. 288–294, Oct., 1903.)—The author has already [see Abstracts Nos. 1274 and 1275 (1903)] used the relation $[T/C \times D]^2 = n$ to express the degree of polymerisation of liquid and solid organic compounds (T is the absolute boiling-point, C a constant, D the density at 0°, n the number of atoms in the molecule and therefore a measure of the degree of polymerisation). In the present paper inorganic substances only are studied, with the results given in the following table :—

Substance.	*n* calculated for the		Substance.	*n* calculated for the		Substance.	*n* calculated for the	
	Solid.	Liquid.		Solid.	Liquid.		Solid.	Liquid.
HF	14	9	B_2O_3	83	—	H_3PO_3	18	—
KCl	100	—	KNO_3	34	—	H_2SO_4	9	10
KF	73	—	$NaNO_3$	26	—	K_2SO_4	100	—
NaCl	94	—	$NaPO_3$	52	—	Na_2SO_4	72	—
NaF	72	—	$KClO_3$	26	—	H_3BO_3	39	—
H_2O	29	14	$NaClO_3$	25	—	N_2O_5	14	—
H_2S	—	5	$POCl_3$	—	5	$Na_2S_2O_3 . 5H_2O$	14	—
SO_2	—	3	P_2S_3	12	10	H_3PO_4	11	—
CS_2	—	6	SO_2Cl_2	—	4	Si_2Cl_6	—	8
N_2O	—	4	$SiCl_4$	—	5	NH_4NO_3	25	—
Cl_2O	—	3	HNO_3	—	5	P_4O_6	9	—
CNH	52	18	Cl_2O_4	—	4	$H_2S_2O_7$	11	—
PCl_3	—	4	N_2O_4	—	4	Al	49	—
NH_3	40	14	$KClO_4$	48	—	Cl_2	—	3
$SOCl_2$	—	4	C_2Cl_4	—	6	K	60	132
S_2Cl_2	—	6	$K_2 . CO_3$	121	—	Li	146	—
SO_3	9	3	Na_2CO_3	119	—	Mg	151	—
NO_2Cl	—	4	H_3PO_2	14	—	Na	56	108
C_2N_2	30	8	H_4P_2	—	11	P (ord.)	12	9
CNSK	20	—	SO_3HCl	—	6	S	14	12
$COCl_2 . 6H_2O$	16	4						

D. H. J.

2762. *Constitution of Copper-Tin Alloys.* **C. T. Heycock** and **F. H. Neville.** (Roy. Soc., Phil. Trans. 202. pp. 1-69, Oct. 2, 1903. Bakerian Lecture.)—The authors disclaim any material advance in the results given in the present paper as compared with those given in their paper of 1901 [see Abstract No. 1882 (1902)]; the temperature-concentration diagram representing these results is very similar to that reproduced with the above Abstract, but it differs from it in being more accurate, and a stricter notation is employed, the bodies formerly denoted as Cu_3Sn and CuSn being now denoted as η and H respectively, their composition having been more accurately determined and interpreted in the light of the theory of solutions. The present paper is devoted to a full exposition of the evidence upon which the previously published conclusions are based, the cooling curves of a number of alloys, and over 100 photomicrographs being reproduced. The authors found that the microstructure of copper-tin alloys which have been allowed to cool in the ordinary way does not correspond to the primary crystallisation which can be traced by the dendritic markings found on the surface of ingots, and they suspected recrystallisation subsequent to the first solidification. The constitution of the alloys at various temperatures is therefore investigated by means of ingots rapidly cooled from those temperatures by means of chilling, in the hope of thus stereotyping the structure as existing at those temperatures. Further, some of the transformations of one solid phase into another are found to take place very slowly, so that the structure corresponding to final equilibrium can only be obtained by maintaining the alloy at a temperature just below that of transformation for a very long time. Both methods are systematically applied to the entire series of alloys. Cooling curves are also utilised, but have the defect that when they are being taken the specimen of metal must be allowed to cool somewhat rapidly, so that the more gradual transformations are far from complete. The authors consider at length the definition of Roozeboom's "liquidus" and "solidus" curves, and show how the microscopic evidence enables them to determine the position of the "solidus" with considerable confidence, since the microstructure of a chilled ingot very clearly indicates what portion—if any—of the ingot was actually liquid at the moment of chilling. In connection with the "solidus" curve, the authors also investigate the strength and rigidity of the alloys at temperatures near to and above the "solidus." A direct transverse breaking test and also a "pull-out" method is employed. It is found impossible to determine the position of the "solidus" in this way, and the conclusion is reached that the alloys remain practically rigid up to temperatures well above the "solidus," indeed, nearly up to the "liquidus," and the authors infer that the alloys give way, not when the eutectic or other mother-substance between the primary combs begins to melt, but at considerably higher temperatures when a good deal of the primary has itself been dissolved. The skeleton crystals of the solid phase form a fairly rigid framework, and are by no means plastic masses. It further follows that recrystallations taking place at temperatures below the "solidus" occur in an already solid and crystalline body. The authors also direct attention to the process of solidification undergone by the various classes of alloys, and point out that the existence of certain of the phases and transformations could not have been discovered but for the study of chilled ingots, while many of the features described could not be explained without the help of the theory of solid solutions. A somewhat rare phenomenon is described in connection with alloys containing from 25 to 27 atomic per cent. of tin; in these there is first a complete crystallisation of homogeneous γ substance; then, as the cooling proceeds, part of the γ is transformed into the η crystals (probably Cu_3Sn); when, however, a certain temperature is reached the residual γ breaks up into η and *liquid*, so that these alloys furnish instances of bodies which can be partially melted by *cooling*. The detailed description and discussion of the observed micro-structure of the alloys cannot be followed without reference to the photographs; in connection with this portion of their paper, however, the authors describe their method of isolating the bodies η and H for analysis. For this purpose they utilise the fact, observed during the etching of the micro-sections of the alloys, that these bodies are practically unacted upon by hydrochloric acid; to obtain the η body the alloy must be sharply chilled from a temperature above 400° C., while to obtain the pure H the alloy must have been maintained at a little below 400° C. for a period long enough to transform all the η. It is claimed that in the observance of these two precautions the present method constitutes an advance on previous work. The ingots of alloy are rapidly disintegrated by the action of strong hydrochloric acid at 30° C., and, if air be excluded, no copper is dissolved until all the excess of tin has been removed. The black mud resulting from this disintegration can be elutriated and leaves well-formed plates of η, or slender filaments of H. Three ingots, of Sn38, Sn50, and Sn70, were treated after three days and nights in boiling sulphur vapour (454° C.), and then chilled, and gave as per cent. of tin in the η the values 38·73, 38·53 (both of Sn38), 39·73, and 38·97 per cent. respectively. Theoretically, the composition of the solid phase at a given temperature should be independent of the composition of the alloy, but the character of the ingot at the moment of chilling affects the possibility of extracting the desired body, as under some conditions inclusions of tin will be unavoidable, and the discrepancies in the results are ascribed to this cause. Further, no method of chilling will avoid the presence of traces of H on the plates of η. The percentage required by the formula Cu_3Sn is 38·35 per cent., and the authors attach this formula to the η body, suggesting that it may contain a little tin in solid solution. On the other hand analyses of H prepared in various ways lead the authors to conclude that the H body is not pure CuSn, but that it may very well be that body containing a little of the higher compound in solution. W. R.

2763. *Aluminium-Tin Alloys.* **W. C. Anderson** and **G. Lean.** (Roy. Soc., Proc. 72. pp. 277–284, Oct. 19, 1903.)—The liquidus of the AlSn alloys, as observed by the authors, is nearly horizontal from 24·8 to 17·43 per cent. Al at a temperature of 563° C. to 560·5° C. The apparent terminations of the heat evolutions are regarded as the solidus, and form a curve which approximates closely to the liquidus when aluminium is less than 15 per cent. From these data it is inferred that the compound AlSn occurs in the alloys, and the authors support the view by microstructural evidence. The amount of hydrogen expelled from water by the members of the series in equal times decreases with the percentage of Al. [See also Abstract No. 2044 (1904).]

F. R.

2764. *Isolonic Coefficients of Various Salts.* **G. Timofeeff.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 35. pp. 640–641, 1903.)—The measurements were made with *Tradescantia discolor*, using de Vries's method, the following being the results :—

	Limits of Concentration (g.-mols. per litre) of Plasmolysed Solution.	Isotonic Coefficients taking *i* for Carbamide as 1.
Ammonium chloride	0·15 —0·18	1·729
„ bromide	0·135—0·18	1·665
„ iodide	0·135—0·155	1·727
Sodium chloride	0·13 —0·18	1·671
„ bromide	0·13 —0·18	1·729
„ nitrate	0·13 —0·145	1·793
Potassium chloride	0·14 —0·175	1·732
„ iodide	0·12 —0·16	1·949
„ nitrate	0·14 —0·18	1·729
Carbamide	0·27 —0·315	[1·000]

These results agree well with those obtained by de Vries and also with the values of *i* given by conductivity measurements.

T. H. P.

2765. *Action of Halogens on Compounds containing the Carbonyl Group.* **A. Lapworth.** (Chem. Soc., Journ. 85. and 86. pp. 30–42, Jan., 1904.)—The author has studied more especially the velocity of bromination and chlorination of acetone. The action of bromine on acetone in dilute aqueous solution is exceedingly slow, but becomes more rapid in presence of acids, the resulting accelerations being of the same order in the case of the more powerful mineral acids, and less obvious in the case of the weaker ones. Neutral salts did not in general produce any marked influence on the speed of reaction. The velocity is nearly proportional to the concentration of acetone, but is practically independent of the concentration of the bromine. It seems probable that the bromination of acetone in the presence of acids is best regarded as the result of a slow, reversible change effected in the acetone by the hydrogen ions, followed by an almost instantaneous bromination of the product—a change which is not appreciably reversible. In the case of interaction of chlorine and acetone, the speed of reaction is more obviously dependent on the concentration of the halogen, but as that concentration diminishes the velocity decreases until it approximates very nearly to that observed when bromine is used under similar conditions. The accelerating influence of acids on the action of bromine and chlorine on other carbonyl compounds appears to be fairly general and is well marked in the case of acetone and other ketones in solvents other than water, and also in the case of carboxylic acids and their anhydrides and esters. A. F.

2766. *Solubility Curves of the Hydrates of Nickel Sulphate.* **B. D. Steele** and **F. M. G. Johnson.** (Chem. Soc., Journ. 85. and 86. pp. 113–120, Jan., 1904.)—The study of the solubility curves of nickel sulphate between — 5° and 100° does not indicate the existence of any hydrate containing less than 6 molecules of water of crystallisation. The authors have made no determinations at temperatures above 100°, but the curves of Étard and Engel (1888) indicate the existence of a transition-point at about 118°, and the analysis by the authors of the solid phase separating at 131° shows it to be the dihydrate, $NiSO_4$, $2H_2O$. The results show that the system, nickel sulphate-water, exhibits the following quadruple points: (*a*) cryohydrate point of the heptahydrate [— 4·15°]; (*b*) transition-point, heptahydrate $\rightleftarrows$ hexahydrate (blue) + saturated solution [31·5°]; (*c*) transition-point, hexahydrate (blue) $\rightleftarrows$ hexahydrate (green) [53·3°]; (*d*) transition point, hexahydrate (green) $\rightleftarrows$ dihydrate + saturated solution (not accurately determined). The equilibrium diagram shows curves corresponding with: ice, the heptahydrate, the blue hexahydrate, and the green monoclinic hexahydrate. T. H. P.

2767. *Relative Strengths of Alkaline Hydroxides as measured by their Action on Cotarnine.* **J. J. Dobbie, A. Lauder,** and **C. K. Tinkler.** (Chem. Soc., Journ. 85. and 86. pp. 121–128, Jan., 1904.)—Cotarnine exists in aqueous solution in two tautomeric forms, an "ammonium" form (hydroxyl attached to nitrogen) and a carbinol form (hydroxyl attached to carbon), between which a definite equilibrium subsists. The former is partially dissociated, and hence the introduction into the system of hydroxyl ions (soluble alkaline hydroxide) decreases this dissociation, disturbs the tautomeric equilibrium and produces more of the carbinol form. It is possible by a careful comparison of ultra-violet absorption-spectra to estimate fairly accurately the relative amounts of the ammonium and carbinol forms present in the solution. In this way the relative strength of the alkaline hydroxides can be measured. The results are in perfect accordance with the theory of ionisation. F. G. D.

2768. *Alteration of Concentration and of Crystallisation of Dissolved Substances by Centrifugalising.* **R. P. van Calcar** and **C. A. Lobry de Bruyn.** (Rec. Trav. Chim. Leiden, 23. pp. 218–223, 1903. Chem. Centralblatt, 2. p. 5, 1904.)—Solutions of potassium thiocyanate, ferrocyanide and iodide, saccharose, and Glauber's salt were used in the investigation, and samples were taken, after centrifugalising, from four different points from the periphery towards the axis. An enrichment of the outermost portion was observed in all cases. A 0·2 normal solution of potassium iodide after three hours' treatment gave values as follows: (1) from inner portion (0·2); (2) 0·1*n*; (3) 0·32*n*; (4) outer portion 0·25*n*. With a solution of Glauber's salt containing 8·78 per cent. of sodium sulphate, crystallisation was observed. After centrifugalisation for five hours a quantity of crystals of Na_2SO_4, $10H_2O$ was filtered off, the residual solution containing then only 5·54 per cent. of sodium sulphate. L. H. W.

2769. *Alloys of Tin and Antimony.* **W. Reinders.** (Inst. Mech. Engin., Proc. 1. pp. 209–214, Jan., 1904. Appendix III. to 6th Report to the Alloys Research Committee.)—The author has determined the freezing-point curve of these alloys by the method of Roberts-Austen, and has investigated the microstructure of various members of the series. The curve consists of four branches; the first begins with pure tin and ends with an alloy containing 8 per cent. Sb, melting at 243° C. There is no eutectic point, the smallest addition of antimony raising the melting-point. This branch of the freezing-point curve corresponds to the separation of crystals of an isomorphous mixture of tin with a maximum of 11 per cent. Sb. The next branch of the curve is considerably steeper, and corresponds to the separation of crystals of a definite compound, which crystallises in small glittering cubes and has a composition represented by Sn_2Sb. The third branch of the freezing-point curve begins with an alloy of about 20 per cent. and extends up to about 50 per cent. Sb. The crystals corresponding to the lower portions of this branch could not be well discerned, but at 50 per cent. Sb they again have a definite form, being thick plates of the composition Sn_4Sb_3. The fourth branch of the curve ends with pure antimony, but the crystals which correspond to it are probably a solid solution of tin in antimony. Sections of these alloys (above 60 per cent. Sb) are difficult to obtain, as the crystals of the antimony type fall out of the surface during polishing; no indications of other crystals than those indicated by the freezing-point curve were, however, observed. The author also determined the recalescence points of the alloys, finding that alloys on the third branch of the curve show three retardations, one of which, at 309° C., is very feeble. Alloys between 50 and 60 per cent. Sb show four retardations during cooling, but two of these disappear in higher alloys. The author draws a temperature-concentration diagram based on his observations and illustrates the microstructure of typical alloys of the series. W. R.

2770. *Reactions of Nickel Carbonyl with Halogens and other Inorganic Substances.* **J. Dewar** and **H. O. Jones.** (Chem. Soc., Journ. 85. and 86. pp. 203–212, Feb., 1904.)—By solutions of chlorine, bromine, iodine, cyanogen, or sulphur in organic solvents, nickel carbonyl is completely decomposed with formation of carbon monoxide and a nickel compound; in no case is a compound of carbon monoxide with the halogen or other reagent observed, even when the latter is in large excess. The heat of formation (52·2 cals.) of nickel carbonyl, when compared with the values for the other nickel compounds, would lead one to expect that chlorine and bromine would readily decompose nickel carbonyl, but not iodine, cyanogen, or sulphur. With iodine the heat required to bring about the reaction seems to be supplied by the formation of molecular complexes of nickel iodide with either the solvent or iodine, while with sulphur, a higher sulphide, probably Ni_2S_3, is formed. Liquid chlorine or bromine decomposes solid nickel carbonyl, but solid iodine is without action on the liquid carbonyl. The reaction with iodine is of the second order. Iodine mono- and tri-chlorides act in two distinct ways: (1) Iodine is liberated according to the equation—

$$2ICl + Ni(CO)_4 = NiCl_2 + I_2 + 4CO,$$

and (2) the iodine reacts with a further quantity of the carbonyl, thus, $I_2 + Ni(CO)_4 = NiI_2 + 4CO$. Hydrogen iodide reacts readily with nickel carbonyl, but hydrogen chloride and bromide do not attack it. Hydrogen sulphide acts slowly and gives nickel sulphide, hydrogen, and carbon monoxide. Sulphuric acid gradually decomposes nickel carbonyl and does not detonate with it, as Berthelot stated; the reaction is—

$$Ni(CO)_4 + H_2SO_4 = NiSO_4 + 4CO + H_2.$$

T. H. P.

2771. *Acid Esters of Methyl Substituted Succinic Acids.* **W. A. Bone, J. J. Sudborough,** and **C. H. G. Sprankling.** (Chem. Soc., Journ. 85. and 86. pp. 534–555, April, 1904.)—From the authors' measurements of the esterification and dissociation constants of the methyl hydrogen esters of succinic acid and its various methyl derivatives, the following conclusions are drawn: I. A single substitution of hydrogen by methyl in the group $H_2:\dot{C}.CO_2H$ or $H_2:\dot{C}.CO_2Me$ always raises the dissociation constant. Thus, (*a*) for $CO_2H.CH_2.CH_2.CO_2Me$, $K=0{\cdot}00321$; $CO_2H.CHMe.CH_2.CO_2Me$, $K=0{\cdot}00390$; $CO_2H.CHMe.CHMe.CO_2Me$, $K=0{\cdot}00455$ (*cis*), $0{\cdot}00605$ (*trans*). (*b*) For methyl hydrogen *as*-dimethylsuccinate from the anhydride, $K=0{\cdot}000228$; methyl hydrogen trimethylsuccinate, $K=0{\cdot}00310$. II. On the other hand, a double substitution of methyl in the group $H_2:\dot{C}.CO_2H$ or $H_2:\dot{C}.CO_2Me$ involves a marked lowering of the constant, as, for example: (*a*) $CO_2H.CH_2.CH_2.CO_2Me$, $K=0{\cdot}00321$; $CO_2H.CMe_2.CH_2.CO_2Me$, $K=0{\cdot}00288$; $CO_2Me.CMe_2.CH_2.CO_2H$, $K.0{\cdot}00256$; $CO_2H.CMe_2.CMe_2.CO_2Me$, $K=0{\cdot}00122$. (*b*) Methyl hydrogen methylsuccinate, $K=0{\cdot}00390$; methyl hydrogen trimethylsuccinate, $K=0{\cdot}00310$ (anhydride), $0{\cdot}00266$ (neutral ester). T. H. P.

2772. *Chemical Dynamics of the Alkyl Iodides.* **Miss K. A. Burke** and **F. G. Donnan.** (Chem. Soc., Journ. 85. and 86. pp. 555–589, April, 1904.)—The authors have studied more particularly the reaction between silver nitrate and alkyl iodides in ethyl alcoholic solution, and discuss here very fully not only their own results, but also the reactions studied by other investigators dealing with the problem of the reactivity of the alkyl iodides. Their main conclusions may be summarised as follows: (1) The reaction between silver nitrate and an alkyl iodide in absolute alcohol at 25·4°, and at concentrations varying from N/20 to N/80 can be expressed in a special form of the bimolecular velocity-equation, in which the velocity coefficient is a function of the initial concentration of the reacting components. (2) It is found that in solutions containing the reagents in equivalent amounts, the velocity coefficient k increases with the initial molecular concentration c, the relation between k and c being $k = Kc^{0{\cdot}53}$, where K is independent of the concentration. (3) This variation of k is chiefly due to the silver nitrate. For solutions containing the same N/40 initial concentration of ethyl iodide and varying (N/20 — N/80) initial concentration c of silver nitrate, the relation between k and c is approximately $k = Kc^{2/3}$. For solutions containing the same initial concentration of silver nitrate and varying initial concentration of ethyl iodide, the value of k decreases as the latter increases, but the rate of decrease is relatively small as compared with the rate of increase produced by silver nitrate. (4) It has not been found possible to explain the variation of k referred to above. In particular, the assumption that it is the silver ions which take part in the fundamental reaction which regulates the speed, does not appear to offer a simple explanation. (5) Similar anomalies have been observed by Hecht, Conrad, and Brückner (Zeitschr. Physikal. Chem. 1889, 4, 273) in the case of ether formation from sodium alkyloxide and alkyl iodide in alcoholic solution; but the explanation of these anomalies proposed by Steger (Rec. trav. chim. 1899, 18, 13), based on assumptions concerning the ionisation of sodium alkyloxide and alkyl iodide in alcoholic solution, does not appear to hold good if the ordinary law of equilibrium is assumed. (6) The theory of alkylene and alkylidene dissociation of the alkyl iodides, proposed by Nef, did not appear to give a satisfactory account of the observed results. (7) The only acid produced in the reaction is nitric acid. The other products of the reaction are ether and alkyl nitrate. (8) If the reactivities of the alkyl iodides are measured by the velocity coefficients of the reaction with silver nitrate in absolute ethyl alcohol (N/40 equivalent solutions at 24·5°), the following is the order obtained (beginning with the greatest): Isopropyl, ethyl, *n*-propyl, methyl, *n*-butyl, isoamyl, isobutyl. The mean values of the velocity coefficients, both in ethyl and in methyl alcoholic solution, are as follows :—

Iodide.	k_{EtOH}.	k_{MeOH}.	$k_{\mathrm{MeOH}}/k_{\mathrm{EtOH}}$.
Methyl	0·000935	0·00180	1·92
Ethyl	0·00220	0·00442	2·00
n-Propyl	0·000984	0·00226	2·29
n-Butyl	0·000686	0·00145	2·11
Iso-butyl	0·000138	—	—
Isoamyl	0·000565	—	—

(9) The above order of reactivities corresponds with the rate of production of free iodine in the alcoholic solutions when exposed to air and light, with the single exception of methyl iodide, the solution of which becomes discoloured at a rate between those of iso-propyl and ethyl iodides. (10) The relative reactivities given above do not agree in many respects with those observed in other reactions which have been studied kinetically, such as the reactions with ethyl sodioacetoacetate, triethylamine, sodium alkyloxide. Compared with these results, isopropyl iodide reacts with abnormally great, methyl iodide with abnormally small velocity. It does not appear possible, therefore, to ascribe the reactivity of the alkyl halides to any uniform cause. (11) So far as the final products and not the kinetics of the reaction are concerned, the production of ether and nitric acid can be accounted for by ionic reactions just as well as by Nef's hypothesis. The investigation is being extended. [See also Abstract No. 1538 (1904).] A. F.

2773. *Velocity of Reaction in Aqueous Solutions near Point of Maximum Density.* **A. Quartaroli.** (Gazetta Chim. Ital. 34. 1. pp. 505–516, 1904.)—The author has measured the velocities of hydrolysis of methyl and ethyl acetates by sodium hydroxide, first at low temperatures and for small intervals of temperature, and then after having artificially lowered the point of maximum density of the water by the addition of methyl or ethyl alcohol. The results show that none of the formulæ suggested for expressing the variation of the velocity of reaction with the temperature represents satisfactorily the changes in the velocity of hydrolysis of methyl and ethyl acetates in aqueous solution between 10° and 0°, whilst the changes at higher temperatures or in solutions containing more than 10 per cent. of methyl or ethyl alcohol are expressed moderately well by these formulæ. T. H. P.

2774. *Constitution of Copper-Zinc Alloys.* **E. S. Shepherd.** (Journ. Phys. Chem. 8. pp. 421–485, June, 1904.)—The author's experiments show that there are no chemical compounds in the copper-zinc series of alloys, but there are six phases which are all solid solutions (designated α, β, γ, δ, ϵ, η), one quadruple point having been observed at 40 per cent. Cu, which was recorded but overlooked by Roberts-Austen. The equilibrium diagram and photomicrographs of the series are given, showing the effects of heat-treatments. The table indicates the structure—the phase present in excess is given first—and also the colour of freshly filed and of fractured surfaces.

Composition, Copper per cent.	Crystals in Cast Alloys.	Colour.	Colour of Fracture.
100–63	$\alpha + \beta$	Red, to full yellow	Yellow
63–54	$\beta + \alpha$	Reddish yellow, with yellowish cast	Yellowish red
54–51	β	Reddish yellow	" "
51–43	$\beta + \gamma$	" "	" "
42–40	$\gamma + \beta$	Yellowish red	Silvery, with pinkish tinge
40–30	γ	Silvery	Silvery, brilliant
30–20	$\gamma + \epsilon + \delta$	Silvery grey to bluish grey	Silvery grey, becoming duller
20–13	ϵ	Bluish grey	Bluish grey
13-2·5	$\epsilon + \eta$	Bluish grey, becoming lighter	Zinc
2·5–0	η	Zinc	"

F. R.

2775. *Basic Properties of Oxygen. Additive Compounds of the Halogen Acids and Organic Substances and the Higher Valencies of Oxygen. Asymmetric Oxygen.* **E. H. Archibald and D. McIntosh.** (Chem. Soc., Journ. 85. and 86. pp. 919–930, June, 1904.)—The authors have prepared a number of compounds of ketones, ethers, and alcohols with halogen hydrides, and have formulated these on the assumption that the valency of oxygen varies from 4 to 12. The following table gives the results of their analyses, of the m.p. of the compounds, and the assumed valency of oxygen :—

	No. of Molecules of Acid.		No. of Molecules of Organic Substance.	Melting-point.	Valency of Oxygen.
HI	1	acetone :	2	— 18°	4
	1	ether :	1	— 18°	4
	2	alcohol :	1	— 70°	6
HBr	1	acetone :	1	— 9°	4
	1	ether :	1	— 40°	4
	2	alcohol :	1	— 85° (?)	6
HCl	5	acetone :	2	— 85°	8
	5	ethyl ether :	1	— 92°	12
	5	methyl ether :	1	— 120° (?)	12
	5	alcohol :	1	— 120° (?)	12

Some of the compounds should, if the formulation is correct, contain asymmetric oxygen. These are under investigation. A. F.

2776. *Crystallisation Velocity of Binary Melts.* **F. Dreyer.** (Zeitschr. Phys. Chem. 48. pp. 467–482, June 21, 1904.)—A study of the effect of the admixture of foreign substances on the velocity of crystallisation, more particularly on the downwards sloping portion of the curve connecting velocity of crystallisation and bath-temperature. In the case of formanilide, some substances diminish the crystallisation velocity in this temperature region, others increase it, whilst in the temperature region of increasing crystallisation velocity all substances, so far as is yet known, diminish the velocity. The diminution of crystallisation velocity caused by admixture of foreign substances cannot in general be regarded as due to a lowering of temperature at the liquid-solid boundary. F. G. D.

2777. *Basic Mercury Salts.* **A. J. Cox.** (Zeitschr. Anorg. Chem. 40. 1. pp. 146–181, June 23, 1904. Chem. Univ. Labor., Breslau, March, 1904.)—This paper forms an interesting and exact study of the hydrolysis of the chromate, nitrate, sulphate, and fluoride of mercuri-ion and the nitrate and sulphite of mercuro-ion from the point of view of the phase-law. The possible basic salts and their conditions of existence in contact with the aqueous solution are given in detail. F. G. D.

2778. *Addition of Hydrogen Haloids to Olefines in Acetic Acid and Aqueous Solutions.* II. **W. N. Ipatieff** and **W. N. Dechanoff.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 36. pp. 659–669, 1904.)—In presence of acetic acid, ethylenic hydrocarbons combine readily with hydrogen bromide or iodide, but only slowly with hydrogen chloride. With hydrogen chloride and iodide this combination always takes place according to the rule discovered by Markownikoff, but with hydrogen bromide a certain amount of abnormal product is always obtained. The proportion of abnormal product formed is different for different ethylenic hydrocarbons, and becomes less as the difference between the amounts of hydrogen united with the carbon atoms on either side of the double linking increases. Thus, with *iso*butylene, containing the complex $.C:CH_2$, the proportion of abnormal product is 6–7 per cent.; with trimethylethylene, containing $:C:CH.$, 10–15 per cent.; and with *iso*propylethylene, containing $.CH:CH_2$, 50 per cent. T. H. P.

2779. *Complex-Formation.* II. *Pyridine Complexes.* **H. Euler.** (Ber. Deut. Chem. Gesell. 37. pp. 2768–2773, 1904.)—Determinations of the stability of pyridine metallic complexes by means of measurements of solubility and e.m.f. show that these complexes are much less stable than those containing ammonia or alkylamines. This is shown by the dissociation constants tabulated below :—

Metal.	Pyridine.	K.	Ammonia.	K.
Ag	$AgPy_2$	4×10^{-5}	$Ag(NH_3)_2$	5×10^{-8}
Ni	$NiPy_2$	$2{\cdot}5 \times 10^{-1}$	$Ni(NH_3)_4$	$1{\cdot}1 \times 10^{-5}$
Cd	$CdPy_2$	$1{\cdot}4 \times 10^{-1}$	$Cd(NH_3)_4$	$3{\cdot}2 \times 10^{-4}$
Zn	$ZnPy_2$	$2{\cdot}8 \times 10^{-1}$	$Zn(NH_3)_4$	$1{\cdot}6 \times 10^{-3}$

T. M. L.

2780. *Solution of Metallic Hydroxides in Alkalies, &c.* **H. W. Fischer.** (Zeitschr. Anorg. Chem. 40. 1. pp. 39–53, June 28, 1904.)—The solubility of copper hydroxide in sodium hydroxide solution diminishes with the concentration of the latter, and is only slightly influenced by the presence of sodium carbonate or potassium carbonate. The solubility of chromic hydroxide in aqueous red chromic chloride increases with, but is not directly proportional to the concentration of the latter; a basic chloride is probably formed in the solution. From such a liquid the chromic hydroxide cannot be precipitated by either the addition of an electrolyte or the action of heat; part of the hydroxide is presumably in the colloidal form and part as a chloro-compound. With solutions of aluminium hydroxide in aluminic chloride also part of the former is in the colloidal state and part forms a compound. T. H. P.

2781. *Time Magnitudes of Formation of Complexes, their Constants and Atomic Dimensions.* **F. Haber.** (Zeitschr. Elektrochem. 10. pp. 433–436, July 1, 1904.)—From measurements of the e.m.f. of concentration cells, Ostwald calculated that in a solution of potassium silver cyanide (1/10 norm.) the concentration of silver ion is 2×10^{-18} gm. per litre, or assuming 10^{24} atoms in 1 gm.-atomic weight, say, only 2 ions in each c.cm. The apparent difficulty, that if 1 c.cm. of such a solution were divided into three equal parts, no silver ions would be present in at least one of the parts, was met by Ostwald, who interpreted the concentration-numbers as relative time-numbers, viz., that the silver exists in the ionic state for only 2×10^{-18} part of the time in which it is present in the complex. After showing that the dissociation constant of the complex ion can be regarded as the ratio of time of formation to time of decomposition, the author shows that, assuming 10^{-3} sec. as the time of decomposition with production of silver ions, the time of formation of the complex would be 10^{-24} sec. with unit concentration—a velocity greater than that of light. As a result, the author comes to the conclusion that the reality of the minute concentrations calculated from the measurements of e.m.f. of solutions containing complex ions cannot be asserted without arbitrariness. If the atomic representation be retained, one cannot be certain of the reality of concentrations smaller than that of OH′ in ionic-normal solutions of sulphuric acid. A. F.

2782. *Studies on Enzyme Action.* **E. F. Armstrong** with **R. J. Caldwell.** (Roy. Soc., Proc. 73. pp. 500–537, July 7, 1904.)—The full titles of the three papers are: (II.) Rate of the change, conditioned by sucroclastic enzymes, and its bearing on the law of mass action; (III.) Influence of the products of change on the rate of change conditioned by sucroclastic enzymes; (IV.) Sucroclastic action of acids as contrasted with that of enzymes. The author has studied the hydrolysis of lactose by lactase and emulsin, and of maltose by maltase, special care being taken to obtain uniform solutions of enzyme. He confirms and extends the work of other investigators in this field. The author distinguishes two periods in the course of change—an earlier period during which the change is a linear function of the time; and a later period, during which change proceeds at another rate. The author assumes that combination occurs between hydrolyte and enzyme, and regards the *active mass* of the sugar as being equal not to the total concentration, but to the concentration of the compound so formed. He then considers four cases, viz., (1) that in which, whatever the amount of sugar present, the quantity of enzyme is relatively small; (2) that in which the quantity of enzyme is relatively considerable; (3) that in which the amount of enzyme diminishes as the action proceeds; (4) that in which the amount of sugar present is varied. In the first case it may be assumed that the enzyme will be in presence of enough sugar molecules to establish the maximum possible number of effective combinations, so that the change will be a linear function of the time. When the amount of sugar diminishes, this will no longer be the case, but the rate of change will be a logarithmic function of the time. In the second case, the first, linear portion will escape notice. The author also takes into account the retarding action of the products of hydrolysis, by supposing so much of the enzyme removed by these products. The author believes that the action of enzymes follows a normal course, and that the difficulties in interpreting the changes may be ascribed to the incomplete consideration of the numerous factors involved. In the second of the above-mentioned papers the author studies the action of the enzymes in relation to the configuration of the hydrolyte, and establishes the close relationship of the two factors. In the last of the papers the results of experiments on the hydrolysis of different sugars by acids are communicated. The solutions contained about 18 per cent. sugar. In these experiments it was found that the products of change exercised an accelerating action on the hydrolysis. The value of K at 60·1° for the hydrolysis of milk sugar, maltose, and cane-sugar respectively is 3·53, 4·49, and 4378·0. The authors also give the formula $K = 2{\cdot}27\,(1 + 0{\cdot}03p)$ for the change of the constant with the concentration (p = gm. in 100 c.cm.) of the sugar. As in the case of enzymes, the authors assume the presence of an *active mass* of hydrolyte conditioned by formation of a compound with the acid. A. F.

2783. *Mixed Indicators.* **M. Scholtz.** (Zeitschr. Elektrochem. 10. pp. 549–553, July 29, 1904. From the Chemisches Institut der Universität, Greifswald.)—The behaviour of mixed indicators, which are occasionally made use of in analysis, may give important information concerning the strengths of the indicators as acids or bases. When two indicators are present in an acid solution, the addition of potassium hydroxide first changes the colour of that indicator which is the stronger acid of the two. In this way the relative strengths of the various indicators may be determined. In the following list the first member is the strongest acid: (1) Alizarinsulphonic acid, iodeosin; (2) *p*-nitrophenol; (3) luteol or oxychlorodiphenylquinoxaline; (4) hæmatoxyline, rosolic acid; (5) litmus; (6) turmeric; (7) phenolphthalein. Alizarin comes between (2) and (5), fluorescein between (1) and (5), tropäolin 000 between (3) and (5), cochineal before (5), gallein before (2), lacmoid before (6), phenacetolin before (5), brasilin below (3), and α-naphtholbenzein below (5). The mixed colour is only pure in very highly diluted solutions. In a similar way the strengths of basic indicators may be compared. The author takes methyl orange and tropäolin 00 (sodium phenylaminoazobenzenesulphonate) to be basic indicators, and assumes that only the ionisation processes at the N-group—which are quite independent of those at the sulphonic acid group—come into play in the colour changes. Cyanin is a stronger base than either dimethylaminoazobenzene, methyl orange or tropäolin 00; Congo red also is stronger than the last-named. On neutralising an acid solution containing a basic and acid indicators, the weakest base reacts first, then the stronger bases, and finally the acid indicators.

T. H. P.

2784. *New Primary Cell.* **E. G. P. Bousfield.** (Electro-Chemist, 3. pp. 730–733; Discussion, pp. 733–734, May, 1904. Paper read before the Faraday Soc., April 13, 1904.)—This cell, invented by the author, consists of an inner porous pot containing nitric acid and a carbon pole, and an outer vessel containing sodium hydrate solution and a metal pole, preferably zinc. The best conditions obtain when the liquids are of maximum conductivity, *i.e.*, nitric acid 31 per cent. and sodium hydrate solution 12 to 15 per cent.

The open circuit e.m.f. is then 2·6 volts. A cell containing ½ litre of nitric acid, 1½ litres of sodium hydrate solution, and a zinc electrode of 300 sq. cm. surface formed part of a circuit having a total resistance 0·61 ohm, and gave the following results: At the beginning, P.D. = 2·55 volts, Current = 4·18 amps. After ½ hour, P.D. = 1·71 volts, Current = 2·8 amps. After 12 hours, P.D. = 0·75 volt, Current = 1·1 amps. After 20 hours, P.D. = 0·516 volt, Current = 0·52 amp. Between these values the discharge curves (shown) are approximately straight lines. With solutions of higher resistance the behaviour of the cell was more constant after the quick fall during the first half-hour. Results are given for other acids and metals. In the *discussion*, **W. R. Cooper** said that a porous pot bichromate cell gave practically as good results, that the use of both nitric acid and caustic soda with a porous pot was disadvantageous, and that the working e.m.f. of the cell was really only 1·8 to 1·9 volts. **J. Swinburne** put forward Swan's suggestion of the use of a third neutral electrolyte in a middle compartment. In the reply the **Author** stated that the e.m.f. remained nearly constant for several hours at 2·5 or 2·6 volts if the circuit resistance was from 5 to 10 ohms or more.

J. D. C.

2785. *Theory of Solution.* **J. Traube.** (Phil. Mag. 8. pp. 158–165, Aug., 1904.)—There have always been many opponents of the Arrhenius dissociation theory, and many known phenomena appear to be at variance with it. This is especially true with investigations on solvents other than water. The author follows Clausius, and supposes that dissociation is always followed by association. He derives the Rudolphi–van't Hoff formula from his theory, and shows that Ostwald's is the limiting case for very dilute or non-electrolytes.

H. H. F. H.

2786. *Reduction of Nitro-bodies by Stannous Haloids.* **H. Goldschmidt** and **K. Ingebrechtsen.** (Zeitschr. Phys. Chem. 48. pp. 435–466, June 21, 1904. Chemisches Universitätslaboratorium, Christiania.)—This reaction, instead of being of the tenth order representing the complete reduction of the nitro-compound to amine, is, with constant concentration of hydrogen chloride and varying concentration of the nitro-compound and the tin haloid, of the second order. Just as in the case of electrolytic reduction, nitroso-compounds are formed and these undergo instantaneous reduction. This reduction proceeds proportionally to the first power of the concentration of the hydrogen chloride, so that it is not the $\ddot{Sn}$-ions but the complex ions, $SnCl_3'$ or $SnBr_3$, which act. The reaction should be trimolecular, but, with the large excess of acid employed by the authors, it appears to be bimolecular. The $SnBr'$ ion acts 7·8 times as strong as $SnCl_3$. The reaction constants are given for the reductions of a number of nitro-compounds.

T. H. P.

2787. *Berthelot's Law regarding Electromotive Force of Cells.* **C. J. Reed.** (Amer. Electrochem. Soc., Trans. 4. pp. 151–157, 1903.)—The author objects to the law brought forward by Berthelot [see Abstract No. 935 (1904)], the experimental proof for which is fallacious. The cells in which Berthelot found a measurable e.m.f. are all concentration cells, and the only sources of e.m.f. are the differences in the concentration of an electrolyte at the two electrodes, the chemical energy of the reaction between the acid and the base having no effect whatever. As a substitute for Berthelot's law, the author suggests the following: "When a base acts upon an acid, the e.m.f. developed is zero. When a salt acts upon the corresponding acid or the corresponding base, the e.m.f. developed is also zero. The e.m.f. at the junction of two electrolytes, whether chemical action takes place or no, is zero under all circumstances. The e.m.f. between a platinum plate and an acid, and the e.m.f. between a platinum plate and a base, measured separately, are together equal to the sum of these e.m.f.'s measured simultaneously." As proof of this law, the following experiment is described: Into the three compartments of a cell divided off by two porous partitions are placed in order, sulphuric acid, sodium sulphate, and sodium hydroxide solutions, each containing a platinum electrode, P, P′, and P″. Then the e.m.f. between P and P″ should equal the sum of those between (1) P and P′ and (2) P′ and P″. T. H. P.

2788. *Influence of Current Density in Alternating Current Electrolysis.* **A. Brochet** and **J. Petit.** (Comptes Rendus, 139. pp. 193–196, July 18, 1904.)—On electrolysing nickel in potassium cyanide solution by means of an alternating current, it is found that when the current density remains less than 7 amps. per sq. dm., the yield diminishes as the frequency rises; with higher current densities, however, the yield increases with the frequency to a maximum, the value of which diminishes and corresponds with increasing frequency as the current density is continually increased. As the current density rises, the yield increases rapidly, passing through a maximum, after which the decrease is the more rapid the lower the frequency. With falling frequency and rising current density, the yield approaches zero, although the conditions are approximating to those of a direct current. T. H. P.

2789. *Electrolysis with Smooth and Platinised Platinum Anodes.* **F. Foerster.** (Electrochem. Ind., N.Y. 1. pp. 443–449, Sept., 1903. K. Techn. Hochschule, Dresden.)—When potassium iodide solution is electrolysed with high-current density, more iodine ions will be discharged at the anode than can be brought back by diffusion. The concentration of the iodine ions will therefore become smaller near the anode than in the rest of the solution, and the anode potential will rise; increased diffusion and convection will limit this rise. As rough electrodes offer more surface than smooth electrodes, while their points penetrate further into the liquid, there will be a higher potential at rough than at smooth electrodes; in the case of potassium iodide the difference will be small, however, according to Nernst's theory and to experiments. But when hydrogen and oxygen are evolved the potential will rise noticeably at both electrodes. The author deals particularly with the evolution of oxygen at the anode, in the electrolysis of sulphuric acid, alkali chlorides, and caustic soda, referring to his researches in conjunction with Friessner, Gyr, Jorre, and E. Müller; further with the electrolysis of sodium sulphite, the use of platinised anodes in quantitative analysis (Denso), and electrolytic oxidations; he also draws attention to the use of peroxide anodes of Ni_2O_3, Co_2O_3, MnO_2, as proposed by Coehn and Osaka. Some oxygen seems to be retained by the platinised platinum. [See also Abstracts Nos. 526, 948, 1494, 1513 (1903) and 212 (1904).] H. B.

2790. *Thermo-electric Behaviour of Nickel Nitrate.* **W. McClellan.** (Phys. Rev. 17. pp. 255–266, Oct., 1903.)—The author determines the difference of potential developed between two platinum electrodes immersed in separate beakers containing a solution of nickel nitrate and connected by a tube, the contents of one of the beakers being heated by an electric current while the other is kept cool. Between each experiment the electrodes require rinsing in boiling water, nitric acid, water, and alcohol successively, finally heating to incandescence, this whole treatment being absolutely necessary. Experiments have been made with the boiled and unboiled electrolyte, and with fixed and vibrating electrodes, the latter being attached to the prong of an electrically driven tuning-fork. The results are in all cases very irregular, though much less so for the boiled solution. The effect of vibrating electrodes is not clear, but for good results the electrodes must be arranged with nodes at the surface of the electrolyte. It is concluded that if the thermo-electric power amounts to anything it is probably positive. W. H. Si.

2791. *Electrolytic Estimation of Tellurium.* I. **G. Pellini.** Accad. Lincei, Atti, 12. pp. 312–315, Oct. 18, 1903.)—For the electrolytic estimation of tellurium, the author obtains the best results as follows: A weighed amount (0·1–0·2 gm.) of pure tellurium dioxide, dissolved in 5 c.cm. of concentrated hydrochloric acid, is mixed with 100–120 c.cm. of a cold saturated solution of ammonium hydrogen tartrate and the liquid poured into a Classen's capsule with a matt surface, water being added to bring the total volume up to 160–170 c.cm. The anode employed is a spiral of platinum wire, and the current used 0·02 amp. per 100 sq. cm. at first, and 0·014 amp. later, the voltage being 1·85–2·2; electrolysis is carried out at 55–65°, the volume of the liquid being kept constant by the addition of water. It is important not to carry on the electrolysis longer than is necessary, and to determine its completion, which requires 7–9 hours, about 2 c.cm. of the solution are heated with a few drops of hydrochloric acid and stannous chloride; only a faint brown colouration should thus be produced, the reaction being as follows: $H_2TeO_3 + 2SnCl_2 + 4HCl = Te + 2SnCl_4 + 3H_2O$. Without interrupting the current, the deposited tellurium is washed, as far as possible out of contact with air; water which has been boiled and allowed to cool in a current of carbon dioxide is best used. The current is then stopped, the liquid carefully decanted off, and the precipitate washed once with dilute alcohol and several times with absolute alcohol, then dried for 15 min. at 100° and weighed. The results obtained in this way were very good, and confirm the value 127·6 for the atomic weight of tellurium. T. H. P.

2792. *Electrolysis of Sodium Hydroxide by Alternating Current.* **C. Hambuechen.** (Amer. Electrochem. Soc., Trans. 4. pp. 105–109, 1903.)—An electrolytic rectifier has been devised, based upon the property of aluminium in certain fused salts, of readily permitting the passage of a current towards it and interposing a high resistance to the flow in the opposite direction. Employing a combination of an aluminium and an iron electrode in fused caustic soda simultaneously as a rectifying and electrolytic cell for the production of metallic sodium, an efficiency of about 73 per cent. was obtained, and this figure it is considered can be raised by using an alternating pressure the wave-form of which is flatter. A novel feature in the electrolytic cell used is an aluminium diaphragm surrounding the aluminium electrode, and insulated from it by a porcelain sleeve round the upper portion of the electrode. This is perforated so as to allow a communication of the electrolyte and the passage of the current through it, but prevents the liberated sodium diffusing over to the kathode. W. H. Si.

2793. *Electrolysis of Water.* **J. W. Richards** and **W. S. Landis.** (Amer. Electrochem. Soc., Trans. 4. pp. 111–121; Discussion, pp. 121–125, 1903.)—The authors have continued their experiments, producing high resistance, not as before by using tubes of nearly 9 m. length, but by connecting large electrode vessels by capillary tubes. The electrolysis of sulphuric acid and of sodium carbonate of various concentrations follows Ohm's law, provided the depolarisation by the gases in solution and at the large platinum or gold electrodes be simultaneous with the decomposition; steady readings were obtained within 7 sec. after completing the circuit, and the total pressure, $V = 1{\cdot}50$, represents the sum of the volts required to overcome the ohmic resistance, $Vc = 1{\cdot}02$, and of the volts absorbed in effecting decomposition, $Vd = 0{\cdot}48$. In other experiments two large electrodes were placed 1 cm. apart in sulphuric acid of highest conductivity; with gradually raised pressure the current became constant at 1·8 volts without visible change of the electrolyte, and when the electrodes were then removed, heated to red glow, and replaced, the residual current (Bigelow) again showed the previous constant value, owing to the absorption of hydrogen and oxygen. Visible evolution of gas depended on the current density at the electrodes; a point electrode, positive or negative, opposite a large electrode, gave gas with 1·12 volts; electrodes of equal areas did not evolve gas below 1·5 volts, and with very high resistance, not even at 110 volts. **C. J. Reed** mentioned that with two electrodes of pure lead hydrogen was evolved at 0·5 volt. **Gahl** doubted this; a lead anode rapidly became peroxidised, which was often overlooked in so-called electrolysis with lead electrodes. Like **C. Hering,** he questioned the authors' method of connecting their instruments. H. B.

2794. *Preparation of Electrolytic White Lead.* **C. F. Carrier, Jr.** (Amer. Electrochem. Soc., Trans. 5. pp. 229–232, 1904.)—An account of certain experiments to ascertain the efficiency of production of white lead by electrolysis in various solutions, and the conditions necessary for obtaining a basic carbonate of lead of the proper basicity. The author's observations are tabulated, and it is noted that in order to obtain the correct ratio of carbonate and hydrate of lead the CO_2 supplied to the bath must be diluted with an accurately adjusted amount of air. [See also Abstracts Nos. 177 (1903) and 452 (1904).] J. L. F. V.

2795. *Preparation and Electrolysis of Pure Fused Zinc Chloride.* **S. Grünauer.** (Zeitschr. Anorg. Chem. 39. 4. pp. 389–476, June 13, 1904. Elektrochem. Laborat. des eidg. Polytechnikums, Zürich, Feb., 1903.)—Different specimens of commercial zinc chloride exhibit different behaviour on electrolysis, and it is found that those samples which are readily electrolysed contain ammonium chloride. The most favourable result is obtained on electrolysing a mixture of 11 mols. of zinc chloride with 1 mol. of ammonium chloride. The gases given off at the anode are chlorine, hydrogen chloride, oxygen (from the moisture present in fused ammonium chloride), carbon monoxide, or dioxide and nitrogen; at the kathode hydrogen, ammonia, and nitrogen are evolved. Anhydrous zinc chloride is prepared by heating the ordinary salt, dehydrated as much as possible, with concentrated hydrochloric acid, or by passing dry chlorine into fused zinc, or by adding zinc to molten lead chloride. The author describes experiments on the electrolysis of pure zinc chloride, and on the separation of iron and zinc by the fractional electrolysis of their fused chlorides. T. H. P.

2796. *Electrolytic Oxidation of Anthracene.* **A. Fontana** and **F. M. Perkin.** (Electro-Chemist, 3. pp. 656–663, April; Discussion, pp. 803–805, June, 1904. Paper read before the Faraday Society, May 9, 1904. Elektrochem. Zeitschr. 11. pp. 99–105, Aug., 1904.)—In the electrolytic oxidation of anthracene the best yields of anthraquinone are obtained when acetone is used as solvent and dilute sulphuric acid as electrolyte. The platinum anode is placed in a lead trough; the kathode is also best made of lead, a paddle of the latter metal being used to agitate the solution. By the addition of oxygen carriers, of which the most suitable are chromium, manganese, and cerium salts, the oxidation is very greatly accelerated, even in the absence of a solvent; when one of these is present almost as good results are obtained when the anode and kathode are not separated by a porous cell, provided that the kathode surface is very much smaller than that of the anode. The greatest yield of anthraquinone obtained is 80 per cent., the anthracene employed containing 96 per cent. of the pure product. The authors discuss the various patents taken out for the electrolytic oxidation of anthracene.

T. H. P.

2797. *Rotating Kathodes in the Electrolytic Determination of Metals.* **H. E. Medway.** (Amer. Journ. Sci. 18. pp. 56–58, July, 1904. Contribution from Kent Chem. Laboratory, Yale University.)—Besides the metals previously investigated [see Abstract No. 456 (1904)], it is shown that cadmium, tin, zinc, and gold may be satisfactorily determined by means of a rotating kathode under suitable conditions. Cadmium sulphate should be acidified with dilute sulphuric acid before electrolysis, the solution being afterwards rendered faintly alkaline by addition of ammonia before stopping the current, to prevent solution of cadmium by the acid. The addition of a cold saturated solution of ammonium oxalate is recommended for tin salts, and of potassium oxalate for those of zinc, the rotating kathode preventing the formation of platinum black found in electrolysing zinc salts with stationary electrodes. Gold is best estimated in the presence of a large excess of potassium cyanide and a little strong ammonia. W. H. St.

2798. *Electrolysis of Concentrated Sulphuric Acid.* **B. G. Cobb.** (Chem. News, 90. pp. 26–27, July 15, 1904.)—Using aluminium electrodes $\frac{1}{16}$ in. thick, and a current of e.m.f. 200 volts through an external resistance of 300 ohms, the resistance of concentrated sulphuric acid is practically zero at the beginning of the electrolysis, but quickly rises, so that after half a minute only 0·021 amp. passes. The cause of this is most likely the formation of a non-conducting layer by the hydrogen evolved at the negative pole. The development of gas from the positive pole is accompanied by a darting of gas bubbles all over the surface of the electrode, and very vigorous sparking beneath the liquid. The sparking works gradually up and down the electrode, until after 10 min. the whole surface becomes occupied by it. The spectrum of the sparks shows a line in the green at about $\lambda 5200$. The acid is rendered turbid, owing to the separation of Al_2O_3, $Al_2O_3 . Al_2(SO_4)_3$, and sulphur. In presence of 0·05 per cent. of water or a little nitric acid this light phenomenon ceases, whilst potassium permanganate or bichromate increases the effect. With platinum or silver electrodes no such results are obtained, while pure electrolytic copper electrodes give blood-red sparks after 2½ hours. The light effect is especially brilliant when an aluminium plate is used as the negative, and an aluminium wire wound round with glass wool as the positive electrode. The aluminium employed contains 1·44316 per cent. of sulphur and 0·02233 of insoluble residue. T. H. P.

2799. *Electrolytic Estimation of Manganese.* **J. Köster.** (Zeitschr. Elektrochem. 10. pp. 553–554, July 29, 1904. Communication from the Elektrochem. Laborat. der Tech. Hochschule, Aachen.)—The method of Engels, in which a solution of ammonium acetate and chrome alum is used, is commended. The author finds it advantageous to use a rotating electrode, and carries out the separation in the following way: The anode is best a platinum-iridium basin, and the kathode of platinum revolving at 600 to 700 r.p.m. The electrolyte is 110–130 c.cm. of the manganese salt (not chloride), 5–10 gm. of ammonium acetate, 2–3 gm. of chrome alum, and 1 c.cm. of alcohol. The voltage is 7 and the current density 4–4·5 amps./100 sq. cm. Before closing the circuit the solution is heated to 75°, then the heating flame is withdrawn further from the dish. If the temperature during electrolysis rises above 85°, cold water must be added. To test whether all the manganese has been separated *as peroxide,* add water, and notice if after 5 min. whether a brown colouration appears on the bright part of the dish. In cases where it is not desirable to use chrome alum 10 c.cm. of alcohol may be added. The author finds that with a rotating electrode the alcohol serves as well as chrome alum, and is to be preferred. The following example is given :—

$Mn(NH_4)_2(SO_4)_2 + 6H_2O$ grms.	Current Density, amps./100 sq. cm.	Voltage at Electrodes.	Speed, revs. per min.	Temperature ° C.	Time of Deposit in Minutes.	Mn_3O_4 found.	Mn_3O_4 calculated.
0·7168	4·2	7·5–7·8	600	75–82	20	0·1400	0·1398
1·4336	4·2	7·8–8·0	800	80–82	20	0·2790	0·2796
2·1504	2·0	4·8–5·2	600	80–85	25	0·4191	0·4194

W. W. H. G.

2800. *New Diaphragm for Electrolytic Cells.* **F. M. Perkin.** (Electro-Chemist, 4. pp. 2–4, July, 1904. Note read before the Faraday Soc., June 9, 1904.)—All forms of diaphragm have some drawback. Parchment is often not strong enough, and becomes acted upon by the electrolyte. Asbestos soon falls to pieces. Porous earthenware is difficult to clean, and is apt to disintegrate. In order to avoid these difficulties the author employs an arrangement consisting of two cells of Wedgwood ware or some glazed material, one cell fitting loosely within the other. Each of the cells is perforated with a large number of small holes of such a size that an ordinary pin would pass through. In order to use them as a diaphragm the inner cell is wrapped tightly with asbestos paper until it can just pass down into the outer cell. The asbestos should be wrapped in such a manner that there is considerable overlapping at the bottom end. This is then folded over so as to practically make a bag. About three folds of asbestos paper are usually employed. The prepared diaphragm is soaked in water or electrolyte, and is then ready for use. In some cases filter paper may be used instead of asbestos. Parchment can also be used or a pulp of asbestos blotting-paper, or nitrated cotton-wool may be poured in the annular space. Coarse sand or powdered glass filled in between the pots also makes an exceedingly good diaphragm. After use all that is necessary in order to clear them is to remove the inner cell and to throw away the intermediate substance, after which the cells can be readily cleaned. W. W. H. G.

REFERENCES.

2801. *Holmium.* **S. Forsling.** (K. Svenska Vet. Akad. Handl., Bihang, 28. 2. pp. 1-21, 1902-1903.)—The author has examined the absorption spectra of solutions of different strengths of various fractions of rare earth oxides containing holmium and erbium, and gives the detailed results of the measurements. The methods used for the separation were: (1) Fractionation of the chloride from hydrochloric acid solution and (2) fractionation of the dry chloride by allowing it to deliquesce and removing the liquid portion, the crystals remaining being then dried and again allowed to deliquesce and so on. The results confirm the conclusion previously arrived at by the author, that holmium is not an elementary substance, but a mixture of several components, to which correspond the different absorption bands. It appears probable that the "old" holmium consists not only of dysprosium with its two components, but that at least four other components are present. T. H. P.

2802. *Chemical Valency, Electrical Conductivity, and Hardness of Metals.* **J. G. A. Rhodin.** (Electro-Chemist, 3. pp. 135-140, Sept., 1903.)—As is well known, the molecular combinations of electrolytes in solution, which are practically in the gaseous state, have the same ultimate electrical capacity with varying valencies. The author extends this law to metallic solids, and regards the electrical conductivity of a metal as caused by the transfer of electricity from one section of the conductor to another by means of the motion of the molecular combinations of which it is composed. This motion must be some species of harmonic motion, and for the sake of simplicity, the author takes it as a backwards and forwards motion through fixed points of equilibrium. On this assumption the ordinary equations for conduction in a metal are arrived at. T. H. P.

2803. *Separation of Praseodymium.* **C. R. Böhm.** (Zeitschr. Angew. Chemie 16. pp. 1220-1224, 1903.)—On fractional crystallisation of a mixture of didymium sulphate and potassium nitrate, separation into praseodymium and neodymium was indicated. One component of praseodymium, Pr^{α}, has two bands, $\lambda 596{\cdot}6$ and $589{\cdot}6$. The characteristic bands of the second component, Pr^{β}, are $\lambda 481{\cdot}1$ and $444{\cdot}0$. L. H. W

2804. *Alkaline and Alkaline Earth Metals and their Fused Haloid Salts.* **L. Stockem.** (Metallurgie, 1. pp. 20-26, Jan. 15, 1904. Institut für Metallhüttenwesen und Elektrometallurgie d. K. Techn. Hochschule zu Aachen.)—Attempts have been made to prepare a sub-chloride Na_2Cl by fusing together Na and NaCl in a nickel crucible in an atmosphere of hydrogen. After cooling, the contents of the crucible were found to be in two layers, a layer of Na, and a layer of NaCl. On analysis of the crystals of salt only a small excess of sodium was found, and, therefore, the production of a sub-chloride could not be inferred. The experiment was then repeated under pressure with like results. A sub-chloride also could not be obtained by electrolysis. When metallic calcium was fused with calcium chloride red crystals of Ca_2Cl_2 resulted. Experiments were made with a mixture of Ca and NaCl, also on the melting-point of strontium. W. W. H. G.

2805. *Method of Resolving Fermentation Lactic Acid into its Optically Active Components.* **E. Jungfleisch.** (Comptes Rendus, 139. pp. 56-59, July 4, 1904.)—The author describes the resolution of lactic acid by means of its quinine salt. A. F.

2806. *Determining Accurately the Percentage of Ozone in Gases not Dissociated by a Moderate Heat.* **E. G. P. Bousfield.** (Electro-Chemist, 3. pp. 570–571, March, 1904. Paper read before the Faraday Society.)—The estimation of ozone in a gaseous mixture by the ordinary methods, *e.g.*, the liberation of iodine from potassium iodide, is not very accurate, errors as great as 5 per cent. often occurring. The author describes an apparatus by means of which the expansion is measured, which takes place on heating the ozone to transform it into oxygen. From the amount of expansion the percentage of ozone can be calculated. T. S. P

2807. *Physico-chemical Studies of Tin.* **E. Cohen.** (Zeitschr. Phys. Chem. 48. pp. 243–245, May 27, 1904.)—The author draws attention to a remarkable case of crumbling in tin (Zinnpest), which has occurred in some organ-pipes at Ohlau, Schleswig. Only pipes of those put in during repairs in 1833 are affected, the original pipes being in good condition. Illustrations are given showing the eaten-through appearance of the pipes. [See also Abstract No. 529 (1901).] L. H. W.

2808. *Molecular Weight of Solid Phosphorus Hydride.* **R. Schenck** and **E. Buck.** (Ber. Deut. Chem. Gesell. 37. pp. 915–917, 1904.)—The molecular weight of solid phosphorus hydride $(P_2H)_n$ was determined by the cryoscopic method in yellow phosphorus solution, the values obtained agreeing with the formula $C_{12}H_6$. The molecular depression for yellow phosphorus, determined by the aid of naphthalene, was found to be 332. The theoretical value obtained by Hill (Zeitschr. Phys. Chem., 1893, p. 196) from van't Hoff's equation is 384. L. H. W.

2809. *Constitution of Hydrastinine.* **J. J. Dobbie** and **C. K. Tinkler.** (Chem. Soc., Journ. 85. and 86. pp. 1005–1010, July, 1904.)—The authors have investigated the absorption spectra of hydrastinine. The spectra of the colourless solutions (in alcohol free ether and chloroform) show that this substance, as well as cyanohydrohydrastinine, cyanohydrohydrastinine methiodide and methoxyhydrohydrastinine can be represented by the carbinol formula. In dilute aqueous or alcoholic solutions, however, they appear to have the quaternary ammonium constitution. A. F.

2810. *Radio-activity and the Suggested Variation in Weight in the Case of Certain Reactions.* **G. Martinelli.** (Accad. Lincei, Atti, 13. pp. 217–220, Aug. 21, 1904.)—The author suggests that in the case of certain reactions investigated by Landolt, and by Sanford and Ray [see Abstract No. 299 (1898)], and also by Heydweiller [see Abstract No. 2267 (1900)], the reaction might be accompanied by ionisation of the surrounding air. He tries to find a change in conductivity of the air, but the results are in all cases negative. S. G. S.

2811. *Synthesis of Radio-active Substance.* **J. Joly.** (Nature, 70. p. 395, Aug. 25, 1904.)—A platinum rod which had been subjected, 30 hours before, to radium radiation, when laid on an instantaneous plate for 24 hours, produced the appearance of intense solarisation. The positive ions of radium may possibly take part in synthetic effects, and radium itself may have a synthetic origin. G. E. A.

2812. *Coagulation of Colloidal Silver.* **A. W. Dumansky.** (Jurn. Russk. Fisik.Chimičesk. Obščestva, 36. pp. 465–468, 1904.)—As regards their action on colloidal solutions of silver prepared by Carey Lea's method, metallic salts may be divided into two groups: (1) Salts of oxides of metals of which sub-oxides also exist, such as mercuric chloride, cupric chloride, ferric chloride, &c.; these change into salts of the sub-oxides. (2) This comprises salts of oxides to which no sub-oxides correspond and also salts of sub-oxides. Such salts either reduce the silver to metal or coagulate it, losing part of their acid, or do not undergo change, but precipitate the silver, as happens with salts of ferrous oxide. T. H. P

2813. *Velocity of Transformation of Persulphuric Acid into Caro's Acid.* **M. Mugdan.** (Zeitschr. Elektrochem. 9. pp. 719–721, Aug. 27, 1903. Chem. Institut der Universität, Breslau.)—The velocity of transformation of persulphuric acid dissolved in sulphuric acid into Caro's acid (which is, according to the author, $H_2S_2O_9$ rather than H_2SO_5), is proportional to the concentration of the persulphuric acid solution. The velocity is diminished by addition of potassium sulphate. D. H. J.

2814. *Spontaneous Decomposition of Silver Peroxynitrate.* **E. Mulder.** (Rec. Trav. Chim., Leiden, 22. pp. 385–386, 1903.)—On Nov. 28, 1895, the author set aside a specimen of silver peroxynitrate, $3Ag_2O_2$, $AgNO_3$, O_2, and has since determined its annual loss of weight (due to evolution of O) during the period ending Dec. 18, 1901. From tables given the average weekly loss of oxygen per gm. of the salt varied from 0·000038 gm. in the sixth year to 0·00067 in the fourth year. The loss is stated to take place from that part of the molecule represented by $AgNO_3$, O_2. L. H. W

2815. *Colloidal Silver.* **A. Lottermoser.** (Journ. Prakt. Chem. 68. pp. 357–368, 1903.)—The author considers Hanriot's view that all the varieties of colloidal silver are only highly complex silver compounds is untenable. All these substances are held to be mixtures of silver colloid with other colloids, partly organic and partly inorganic, and a comprehensive table of all the reactions of the different varieties of colloidal silver is given. L. H. W.

2816. *Growth of Bacteria in Strong Salt Solutions.* **F. Lewandowsky.** (Arch. Hygiene, München, 49. pp. 47–61, 1904.)—With equal molecular concentration sodium salts act more strongly than potassium salts. The most concentrated solution of NaCl in which bacterial growth took place was 25 per cent. (4·3 mols.). In broth solutions saturated with potassium nitrate the growth was very active, thus confirming Patterson's results. L. H. W.

2817. *Iodometric Determination of Degree of Hydrolytic Decomposition of Salts.* **W. E. Pawloff** and **D. G. Gerassimoff.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 36. pp. 566–572, 1904.)—A preliminary paper, describing a method by which the degree of hydrolytic dissociation of salts is measured by determining the amount of iodine evolved when the salt is mixed with potassium iodide and iodate. The results obtained with a number of salts and with sulphuric acid are given in tabular form. T. H. P.

2818. *Properties of Mixtures of Nitric and Sulphuric Acids.* III. **A. V. Saposchnikoff.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 36. pp. 669–671, 1904.)—The author has determined the sp. gr. and specific conductivities of mixtures in varying proportions of nitric acid of sp. gr. 1·48 and sulphuric acid. A very small addition (5 per cent.) of nitric acid increases the conductivity of sulphuric acid ten times; this is due to the presence in the nitric acid of water, which produces the same effect. [See also Abstract No. 2210 (1904).] T. H. P.

2819. *Form Assumed by Thallium Iodide on Separating from Solution.* **D. Gernez.** (Comptes Rendus, 139. pp. 278–281, July 25, 1904.)—The author finds that when a saturated solution of yellow thallium iodide is slowly cooled in presence of excess of the salt, the deposited iodide also takes the yellow form, whereas if the saturated solution is filtered off, and the filtrate cooled, the red iodide deposits. If the boiling saturated solution is suddenly placed in cold water, the red modification is precipitated, even in presence of the undissolved yellow salt, and though the red is the unstable variety at temperatures below 168° C. [see Abstract No. 2400 (1904)], it retains its form for a considerable time, the transformation not having been complete in some cases after two years. Thallium iodide only dissolves to the extent of 1 in 15,625 of water, and 1 in 62,500 of alcohol, but is much more readily soluble in aqueous solutions of many salts. W. H. St.

2820. *Solubility and Polymerisation of Cyanogen.* **Berthelot.** (Comptes Rendus, 138. pp. 1649–1652, June 27, 1904.)—The solubility of cyanogen in water or alcohol cannot be measured, as chemical reactions occur whose exact character does not appear to have been elucidated. In the case of solvents such as glacial acetic acid, chloroform, benzene, &c., the chemical interactions are not so marked. F. G. D.

2821. *Enzyme Action as Bearing on the Validity of the Ionic Dissociation Hypothesis and on the Phenomena of Vital Change.* **H. E. Armstrong.** (Roy. Soc., Proc. 73. pp. 537–542, July 7, 1904.)—In the present communication the author discusses the problem of chemical change, especially under the influence of enzymes. The results obtained by E. F. Armstrong [see Abstract No. 2782 (1904)] are considered as strengthening his view, put forward many years ago, that association is the chief factor producing chemical change. A. F.

2822. *Basic Zirconium Sulphate.* **O. Hauser.** (Ber. Deut. Chem. Gesell. 37. pp. 2024–2026, 1904.)—No sparingly soluble crystalline compound of zirconium has yet been described, and this has greatly retarded the work of separating purified derivatives of the element. A systematic investigation of the basic salts has shown that the basic sulphate, $4ZrO_2,3SO_3,14H_2O$ satisfies the required conditions. T. M. L.

2823. *Sodium Amalgams.* **A. Schüller.** (Zeitschr. Anorg. Chem. 40. 3. pp. 385–399, July 30, 1904. Laborat. für anorg. Chemie, Göttingen.)—The author gives the melting-point curve for mixtures in all proportions of sodium and mercury. Methods of preparation are given for the following seven compounds: $NaHg_4$, $NaHg_2$, $Na_{12}Hg_{13}$, $NaHg$, Na_3Hg_2, Na_5Hg_2, and Na_3Hg. T. H. P.

2824. *Single Potentials of Sodium and Potassium.* **H. E. Patten** and **W. R. Mott.** (Electrochem. Ind., N.Y. 1. pp. 450–451, Sept., 1903.)—The authors give the results of their determinations of the potentials of potassium and sodium towards various electrolytes, both aqueous and non-aqueous; the numbers obtained are in good agreement with the calculated values. Confirmation is given of the view that metals which give potentials lower than the theoretical ones, *e.g.*, magnesium, aluminium, and manganese, do so rather because of the formation of a film upon them than because the metals decompose the solution with liberation of hydrogen. The oxides and hydroxides of the alkali metals, as well as their alkoxides, are soluble, so that no film is formed, and the single potentials observed are in fairly close agreement with the calculated values. The hydrogen formed does undoubtedly exert some influence, but only very little. T. H. P.

2825. *Metallic Diaphragms.* **E. A. Byrnes.** (Elect. World and Engineer, 42. p. 520, Sept. 26, 1903. Paper read at Niagara Falls Meeting of the American Electrochem. Soc.)—Various electrically conducting materials, *e.g.*, lead, become poor conductors when in finely powered form, and may then be used for metallic diaphragms. Several different mechanical arrangements for the construction of the diaphragm are possible; for instance, the finely crushed material may be included between perforated iron plates. T. H. P.

2826. *Electrolysis of an Aqueous Solution of Silver Selenate.* **E. Mulder.** (Rec. Trav. Chim., Leiden, 22. p. 387, 1903.)—A current passed for 72 hours through a saturated solution (0·835 gm. per litre) of silver selenate in water effected no change. This, taken in conjunction with the fact that selenic acid acts as an oxidising agent towards hydrochloric acid, is considered to show that an acid of the formula H_2SeO_5 does not exist. L. H. W.

2827. *Electrolytic Reduction of Potassium Chlorate.* **G. H. Burrows.** (Journ. Phys. Chem. 7. pp. 537–538, Oct., 1903. Correction.)—The author states that he overlooked that nitric acid containing nitrogen oxides reduces potassium chlorate; that would diminish his efficiency of 200 per cent. to 160 or 170 per cent. Brochet [see Abstract No. 218 (1904)] had objected that copper chlorate was reduced to chloride in the presence of metallic copper. This the author admits under reservation. As the solution showed a deposit of spongy copper on the kathode, when copper anodes were used, a direct reduction of the potassium chlorate by the action of this copper in the sense of Binz, or by the hydrogen occluded by this copper (Gladstone and Tribe), would further take place. [See Abstract No. 173 (1903).] H. B.

2828. *Electrolytic Preparation of Adipic Acid.* **L. Bouveault.** (Bull. Soc. Chim. 29. 3. pp. 1038–1043, 1903.)—A solution of sodium methyl succinate, when electrolysed, furnished 70 per cent. of the theoretical amount of methyl adipate. The apparatus employed consisted of a flask with indiarubber stopper carrying an iron wire in contact with a layer of mercury (constituting the negative electrode). The positive electrode was a spiral tube of platinum, through which a rapid current of cold water circulated. The electrolyte had a resistance of 4 ohms, and a current of 7 to 8 amps., and 25 to 30 volts, was necessary to effect the change. Sodium ethyl succinate dissolved in ethyl alcohol proved to be of too high a resistance for the preparation of ethyl adipate by this process, but aqueous solutions of the salt when electrolysed gave small yields of ethyl adipate, the properties of which are described. L. H. W.

2829. *Electrolytic Enriching of Radium from Radium-Barium Preparations.* **E. Wedekind.** (Chem. Zeit. 28. pp. 269–270, 1904.)—On radium-barium chloride, freshly prepared from crude radium-barium carbonate, being electrolysed (mercury kathode and platinum anode), the amalgam formed at the beginning of the electrolysis was found to be more strongly radio-active than that formed later. L. H. W.

2830. *Electrolytic Deposition of Palladium.* **R. Amberg.** (Zeitschr. Elektrochem. 10. pp. 386–387, June 3, 1904. Communication from the Elektrochem. Laborat. der Techn. Hochschule, Aachen.)—An historical account of the processes that have been used for the deposition of palladium, with remarks on the proper voltage to use. The method adopted by the author for the determination of the atomic weight of palladium is described. W. W. H. G.

2831. *Rotating Electrodes in Electro-analysis.* **R. Amberg.** (Zeitschr. Elektrochem. 10. pp. 385–386, June 3, 1904. Communication from the Elektrochem. Laborat. der Techn. Hochschule, Aachen.)—Reference is made to the work of Klobukow, Classen, Gooch and Medway, Exner, Dennis and Geer, A. Fischer, and J. Köster, who have used rotating electrodes in analytical methods. A satisfactory explanation of the extraordinarily satisfactory results of this method is yet required. W. W. H. G.

2832. *Electrolysis of Rapidly Moving Electrolytes.* **H. Sand.** (Zeitschr. Elektrochem. 10. pp. 452–454, July 8, 1904. University College, Nottingham, June, 1904.)—The importance of the changes of concentration at the electrodes in preventing good deposition at high-current densities is discussed. By the agitation of the electrolyte these changes are prevented. W. W. H. G

2833. *The Bell Method of Electrolysis.* **G. Adolph.** (Zeitschr. Elektrochem. 10. pp. 449–450, July 8, 1904.)—The communication of O. Steiner [see Abstract No. 2373 (1904)] is discussed especially with reference to the formation of the neutral layer when carbon and platinum electrodes are used. W. W. H. G.